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### *An account of Mr. James Brindley, the late celebrated Civil Engineer.**

James Brindley was born at Tunsted, in the parish of Wormhill, Derbyshire, in 1716. His father was a small freeholder, who dissipated his property in company and field amusements, and neglected his family. In consequence, young Brindley was destitute of even the common rudiments of education, and till the age of seventeen, was casually employed in rustic labours. At that period, he bound himself to one Bennet, a mill-wright, at Macclesfield, in Cheshire, where his mechanical genius presently developed itself. The master being frequently absent, the apprentice was often left for weeks together, to finish pieces of work, concerning which he had received no instruction; and Bennet, on his return, was often greatly astonished to see improvements in various pieces of mechanism, of which he had no previous conception. It was not long before the millers discovered Brindley's merits, and preferred him, in the execution of their orders, to the master or any other workman. At the expiration of his servitude, Bennet being grown into years, he took the management of the business upon himself; and by his skill and industry, contributed to support his old master and his family in a comfortable manner.

In process of time, Brindley set up as a mill-wright, on his own account, and by a number of new and ingenious contrivances, greatly improved that branch of mechanics, and acquired a high reputation in the neighbourhood. His fame extending to a wider circle, he was

* From the late Dr. John Aikin's "Description of the country round Manchester."

employed, in 1752, to erect a water-engine, at Clifton, in Lancashire, for the purpose of draining some coal-mines. Here he gave an essay of his abilities, in a kind of work for which he was, afterwards, so much distinguished, driving a tunnel under ground, through a rock nearly six hundred yards in length, by which water was brought out of the Irwell, for the purpose of turning a wheel fixed thirty feet below the surface of the earth. In 1755, he was employed to execute the larger wheels for a silk-mill, at Congleton; and another person who was engaged to make other parts of the machinery, and to superintend the whole, proving incapable of completing the work, the business was entirely committed to Brindley; who not only executed the original plan in a masterly manner, but made the addition of many curious and valuable improvements, as well in the construction of the engine itself, as in the method of making the wheels and pinions belonging to it. About this time, too, the mills for grinding flints in the Staffordshire potteries, received various improvements from his ingenuity.

In the year 1756, he undertook to erect a steam engine, on a new plan, at Newcastle-under-line; and he was, for a time, very intent upon a variety of contrivances for improving this useful piece of mechanism. But from these designs he was, happily for the public, called away to take the lead in what the event has proved to be a national concern of capital importance—the projecting the system of canal navigation. The duke of Bridgewater, who had formed his design of carrying a canal from his coal works, at Worsley, to Manchester, was induced, by the reputation of Mr. Brindley, to consult him on the execution of it; and having the sagacity to perceive, and strength of mind to confide in, the original and commanding abilities of this self-taught genius, he committed to him the management of the arduous undertaking. Mr. Brindley, from the very first, adopting those leading principles in the projecting of these works, which he ever afterwards adhered to, and in which he has been imitated by all succeeding engineers. To preserve as much as possible the level of his canals, and to avoid the mixture and interference of all natural streams, were objects at which he constantly aimed. To accomplish these, no labours and expense were spared; and his genius seemed to delight in overcoming all obstacles to them, by the discovery of new and extraordinary contrivances.

The most experienced engineers upon former systems, were amazed and confounded at his projects of aqueduct bridges over navigable rivers, mounds across deep vallies, and subterraneous tunnels; nor could they believe in the practicability of some of these schemes, till they saw them effected. In the execution, the ideas he followed were all his own; and the minutest, as well as the greatest, of the expedients he employed, bore the stamp of originality. Every man of genius is an enthusiast. Mr. Brindley was an enthusiast in favour of the superiority of canal navigation, above those of rivers; and this triumph of art over nature, led him to view, with a sort of contempt, the winding stream in which the lover of rural beauty so much delights. This sentiment he is said to have expressed in a

striking manner, at an examination before a committee of the house of commons, when, on being asked, after he had made some contemptuous remarks relative to rivers, what he conceived they were created for:—he answered, "to feed navigable canals." A direct rivalry with the navigation of the Irwell and the Mersey, was the bold enterprise of his first great canal; and since the success of that design, it has become common all over the kingdom, to see canals accompanying, with insulting parallel, the course of navigable rivers.

After the successful execution of the duke of Bridgewater's canal to the Mersey, Mr. Brindley was employed in the revived design of carrying a canal through the counties of Chester and Stafford. This undertaking commenced in the year 1766; and from the great ideas it opened to the mind of its conductor, of a scheme of inland navigation, which should connect all the internal parts of England with each other, and with the principal sea-ports, by means of branches from this main stem, he gave it the emphatical name of the *Grand Trunk*. In executing this, he was called upon to employ all the resources of his invention, on account of the inequality and various nature of the ground to be cut through; in particular, the hill of Harecastle, which was only to be passed by a tunnel of great length, bored through strata of different consistency, and some of them mere quicksand, proved to be a most difficult, as well as expensive obstacle, which, however, he completely surmounted. While this was carrying on, a branch from the Grand Trunk, to join the Severn near Bewdley, was committed to his management, and was finished in 1772. He also executed a canal from Droitwich to the Severn; and he planned the Coventry canal, and for some time superintended its execution, but on account of some difference in opinion, he resigned that office. The Chesterfield canal, was the last undertaking of the kind which he conducted, but he only lived to finish some miles of it. There was, however, scarcely any design of canal navigation set on foot in the kingdom, during the latter years of his life, in which he was not consulted, and the plan of which he did not either entirely form, or revise and improve. All these it is needless to enumerate; but as an instance of the vastness of his ideas, it may be mentioned, that on planning a canal from Liverpool, to join that of the duke of Bridgewater's, at Runcorn, it was part of his intention to carry it by an aqueduct bridge across the Mersey, at Runcorn-gap, a place where a tide sometimes rising fourteen feet, rushes with great rapidity through a sudden contraction of the channel. As a mechanic and engineer, he was likewise consulted on other occasions; as with respect to draining of the low lands in different parts of Lincolnshire, and the isle of Ely, and to the cleansing of the docks of Liverpool, from mud. He pointed out a method, which has been successfully practised, of building sea-walls without mortar; and he was the author of a very ingenious improvement of the machine for drawing water out of mines, by the contrivance of a gaining and losing bucket.

The intensity of application, which all his various and complicated employments required, probably shortened his days, as the number

of his undertakings, in some degree, impaired his usefulness. He fell into a kind of chronic fever, which, after continuing some years, with little intermission, at length wore out his frame, and put a period to his life, on September 27th, 1772, in the fifty-sixth year of his age. He died at Turnhurst, in Staffordshire, and was buried at New Chapel, in the same county.

In appearance and manners, as well as in acquirements, Mr. Brindley was a mere peasant. Unlettered and rude of speech, it was easier for him to devise means for executing a design, than to communicate his ideas concerning it to others. Formed by nature for the profession he assumed, it was there alone that he was in his proper element; and so occupied was his mind with his business, that he was incapable of relaxing in any of the common amusements of life. As he had not the ideas of other men to assist him, whenever a point of difficulty in contrivance occurred, it was his custom to retire to his bed, where, in perfect solitude, he would lie, for one, two, or three days, pondering the matter in his mind, till the requisite expedient had presented itself. This is that true inspiration, which poets have almost exclusively arrogated to themselves, but which men of original genius, in every walk, are actuated by, when, from the operation of the mind, acting upon itself, without the intrusion of foreign notions, they create and invent. A remarkably retentive memory, was one of the essential qualities brought to his mental operations. This enabled him to execute all the parts of the most complex machine, in due order, without the help of models or drawings, provided he had once accurately settled the whole plan in his mind. In his calculations of the power of machines, he followed a plan peculiar to himself; but, indeed, the only one he could follow, without instruction in the rules of art. He would work the question some time in his head, and then set down the result in figures; then taking it up in this stage, he would again proceed by a mental operation to another result; and thus he would go on by stages, till the whole was finished, only making use of figures to mark the several results of his operations. But though, by the wonderful powers of native genius, he was thus enabled to get over his want of artificial method, to a certain degree, yet there is no doubt, that when his concerns became extremely complicated, with accounts of various kinds to keep, and calculations of all sorts to form, he could not avoid that perplexity and embarrassment which a readiness in the processes carried on by pen and paper can alone obviate. His estimates of expense, have, generally, proved wide of reality; and he seems to have been better qualified to be the contriver, than the manager of a great design. His moral qualities were, however, highly respectable. He was far above envy and jealousy, and freely communicated his improvements to persons capable of receiving and executing them; taking a liberal satisfaction in forming a new generation of engineers, able to proceed with the great plans, in the success of which he was so deeply interested. His integrity and regard to the advantage of his employers, were unimpeachable. In fine, the name of *Brindley* will ever keep a place among the small

number of mankind, who form eras in the art or science to which they devote themselves, by a large and durable extension of their limits.

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*On an improved mode of preparing and employing Wood-Screws.*
*By* MR. JOHN FORD, *Mechanist.*

IT is well known that the points of wood-screws, are generally terminated by the thin shell of the worm; now this, especially in hard wood, frequently turns or yields, so as, in fact, instead of merely penetrating the wood, and leaving a thin screw-like passage for the worm of the screw, that blunted end bores a groove as wide as its own increased thickness, and thus considerably affects the firmness of the screw in the wood. Now, instead of this, Mr. Ford files the points of his wood-screws into a conical form, thus entirely removing that hurtful thin shell of the worm, and he also prepares another of the same sized screws, so as to serve the office of a tap, to open the hole in a screw-like manner; and he thus greatly facilitates the entrance of the screw itself into the hole afterwards. This he effects, by filing away the threads flat on four sides, into a square form, and with sharp angular edges to them; and also flattens or spreads the conical screw head broad, so as to serve to turn the tap so formed, more conveniently than if it had been left of its original conical shape.

In using wood-screws endways of the grain of the wood, and particularly when the screws are to be frequently put in and taken out again, Mr. Ford finds this practice eminently useful; and that now we have published it, we have no doubt that it will be frequently adopted in practice. [*Tech. Rep.*

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*An account of the improved modes of working hard Wood, Cast-Iron, Brass, &c. into shape; practised by* MR. JOHN FORD, *Engineer.*
*By* THOS. GILL, ESQ.

MR. FORD, who has frequent occasion for making models for casting from, in Spanish mahogany, or other hard as well as soft woods, has found that he can make much greater despatch in working it into shape, by employing the broader part of a coarsely toothed key-hole saw, about six inches long, and mounted in a handle, than by using rasps as usual; as every tooth of the saw, in the manner he uses it, cuts away a stripe of the wood, like the grooved and toothed plane-irons used for hard woods, and it never clogs, as the teeth of rasps always do.

In using this saw, he lays it nearly flat upon the wood, but with its back a little raised, and its toothed edge resting upon the wood; he then takes the end of the saw between the thumb and fingers of

his left hand, his right hand grasping the handle of the saw, and carries it rapidly from the point to the heel, across the face of the wood, and back again; at the same time, also, moving its edge sideways, or obliquely to the right and left, and frequently crossing the strokes, or working the saw in the reverse directions, backwards and forwards over the surface he is working upon. In this curious mode of employing the saw, it is wonderful to see the despatch he makes. The higher he raises the back, the more rank, or coarse, the saw cuts; and, on the contrary, the nearer the blade is towards a horizontal posture, or flat upon the work, the smoother it works. And he can thus, from practice, work exceedingly true with it.

We have, formerly, noticed Mr. Ford's curious mode of removing the outer hard crust from iron castings, by employing a coarse round file, termed a rat's tail file, much in the same manner as he here uses a saw on wood, but occasionally turning the file to a fresh part of its surface, when it had become dull from the wear of the hard iron and sand upon it. In this way, he very soon got through the hard crust, and down to the softer and inner part of the casting, when he worked it in the usual manner, but with much greater neatness and precision than is usually effected on cast-iron. He also clears away the scale on forged iron and steel, in the same manner.

We have, in the preceding article, noticed Mr. Ford's improved mode of finishing the points of, and using, wood-screws. Mr. Ford also employs a cast-iron strike-block, or plane, in truly finishing the flat surfaces of his wood work, and with great advantages over the usual wooden planes, however well they may be made. He has fitted an upright wooden handle upon the end of the strike-block, and another upon the wedge of the plane-iron, and which he finds greatly conduce to the ease of working with it. We can, with great confidence, recommend this mode of employing the cast-iron strike-block, upon the harder kinds of wood, as well as upon the brass, gun metal, or cast-iron surfaces, it is usually employed upon, and with so great an advantage, in point of truth and accuracy.

Mr. Ford produces a beautiful surface upon his cast-iron, steel, and brass works, by means of emery sticks, and others coated with crocus; and which he prepares in the following superior manner:—

He usually mixes drying linseed oil, in the proportion of one-eighth part, with his glue, and with this he coats the surfaces of pieces of soft yellow pine, fir, or deal, without turpentine or knots, which are about eight inches long, and five-eighths of an inch square, and are nicely planed smooth. He first lays on a coat of thin glue, and when that is dry, another composed of glue mixed with the emery or crocus, and then instantly sifts over the wet surface, the emery, or crocus, in powder, by means of a sieve. He employs emery of different degrees of fineness, and has sticks thus coated with each, to be used in succession, to smoothen the work; and, lastly, uses those coated with glue and crocus, to give the finishing polish to it.

These emery and crocus sticks, are very durable, and are equally useful, to be employed on works in the lathe, as well as upon flat surfaces, and are greatly superior to the glass, or emery, papers ordi-

narily used; and infinitely so to the employment of emery mixed with oil, and applied upon sticks in the common way of doing it. He usually removes the angles, for about three inches at one end of the stick, to round it and make it serve as a handle to hold it by; and coats only the other five inches with the emery or crocus. He, also, when they are become quite dry, as at the end of nine or ten days' time, rubs them over with sweet oil. He also, occasionally, uses oil with them, in smoothening his work, in the same manner as in using smooth files. He also, sometimes, makes the pieces of wood broader than as above stated, for particular purposes. [*Ib.*

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*On the Manufacture of Iron and Steel (Wootz) in India: from "A Journey from Madras, through the countries of Mysore, Canara, and Malabar." By* Francis Buchanan, M. D.

[Continued from page 398, of Vol. 5.]

Near Chin'-náráyan'-durga, the country, for the most part, consists of a rugged valley, surrounded by hills; but the fields between the rocks were formerly cleared, and well cultivated, the rock enabling the soil to retain moisture. Among these rugged spots, the Amildar and myself visited some iron and steel forges, which had, indeed, induced me to come this way. The information procured on the subject, is as follows:

Iron is smelted in various places of the following *talues*, or districts; Madhu-giri, Chin'-náráyan'-durga, Hagalawadi, and Dévaráya-durga. In the first two districts, the iron is chiefly made from the black sand, which the small torrents formed in the rainy season, bring down from the rocks. In the two latter districts, it is made from an ore, called here, Canay Callu, which is found on the hill Kindala Guda, near Muga-Náyakana-Cotay, in the Hagalawadi district. A little of the same iron ore, is, also, procured from a hill, called Kaymutty, near Muso-conda, in the district of Chica-Náyakana-Hully.

The manner of smelting the iron ore and rendering it fit for the use of the blacksmith, is the same here as near Magadi. The people belonging to the smelting-house, are four bellows-men, three men who make charcoal, and three women and one man who collect and wash the iron sand. They work only during the four months in which the sand is to be found; and for the remainder of the year they cultivate the ground, or supply the inhabitants of towns with fire-wood. The four men relieve each other at the bellows; but the most skilful person takes out and manages the working of the iron, and builds up the furnace; on which account his allowance is greater. In each furnace, the workman puts first a basket (about half a bushel) of charcoal. He then takes up as much of the black sand as he can lift with both his hands joined, and puts in double that quantity. He next puts in another basket of charcoal, and the fire is urged

with the bellows. When the first charcoal that has been given burns down, he puts in the same quantity of sand, and one basket of charcoal; and does this again, so soon as the furnace will receive a farther supply. The whole quantity of sand put in at one smelting, measures six hundred and seventeen cubical inches, and weighs, when dry, about forty-two and a half pounds avoirdupois. This gives a mass of iron, which, when forged, makes eleven wedges, each intended to make a plough-share, and weighing fully one and eighty-two one-hundredths of a pound. The workman here, therefore, procure from the ore, about forty-seven per cent. of malleable iron; but, as usual in India, their iron is very impure.

In the forging house, are required three hammermen, one man to manage the forceps (the tongs,) two bellows-men, and four men to supply charcoal, which, for this purpose, is always made of the bamboo. Every day three furnaces are smelted, and thirty-three wedges forged. The workmen are always paid by a division of the produce of their labour; and every fourth day, or when one hundred and thirty-two pieces have been prepared, the division is made as follows:

| | Pieces. |
|---|---|
| To the proprietor | 35 |
| To the *panchála*, who is the foreman at the forge | 10 |
| To the foreman at the smelting-house | 8 |
| To one of the bellows-men, who removes the ashes and dross | 5 |
| To two of the women who wash the sand, at five pieces each | 10 |
| To the remaining sixteen persons, at four pieces each | 64 |
| | 132 |

The *panchála*, or blacksmith, out of his wages, is bound to find all the iron instruments, such as the anvil, the hammers, and the forceps. The proprietor defrays all the other expenses; and these are

| | Fanams. |
|---|---|
| To the keeper of the forest, for permission to make charcoal | 100 |
| To the *gauda* or chief of the village, for leave to gather iron sand | 40 |
| To ditto, for furnace rent | 15 |
| To the *sunca*, or collector of customs | 30 |
| To two pair of bellows for the smelting-house | 42 |
| To ditto for the forge | 24 |
| To sacrifices | 15 |
| To charity for the brachmans | 10 |
| | Fanams 276 |

The buildings are so mean that they go for nothing; and at the beginning of the season, are put up by the workmen in the course of a day.

The stone ore is made into iron, exactly in the same manner; the quantity put into the furnace, and the produce, being nearly the same. The iron from the stone ore, is reckoned better for all the purposes to which malleable iron is applied, but it sells lower than

the iron made from the sand; for this last is the only kind that can be made into steel. The stone iron sells at six pieces for the fanam; and the people who work it are paid by daily wages. The wedges that it forms, are larger than those of the sand-iron, and weigh from three to four *seers* each; so that this iron costs about 6*s*. 10*d*. a hundred weight. The iron made from the sand, sells at four pieces for the fanam, or about 10*s*. 4*d*. a hundred weight; the pieces weighing, according to estimate, only three *seers*. I am inclined, however, to think, that, on an average, they weigh at least a tenth part more; but it would be difficult to ascertain this, as the pieces differ considerably in size, and are never sold by weight.

It must be evident, that in this account the head-man, wishing to conceal his profit, deceived us. For thirty dividends can only take place in the course of four months; and, each dividend giving him thirty-five wedges of iron, he will receive, in all, one thousand and fifty pieces, which, at the usual price, are worth only two hundred and sixty-two and a half fanams; so that in the course of the year, his expenses being two hundred and seventy-six fanams, he would lose thirteen and a half fanams, whilst the lowest workman gets monthly, seven and a half fanams, or about five shillings, which is more than is earned by the common labourers of the country. The point on which I think he attempted to deceive, was in the number of days the people wrought. If they smelted every day in the year, his profits would be very great; but allowing for many interruptions, owing to the avocations of agriculture, and to occasional deficiencies of sand, we may safely suppose that the forge is employed six months in the year, and then the profits of the proprietor will be about one hundred fanams, which is nearly in the same proportion to his stock, as the gains of the breeder of cattle are to his property. At this rate, the quantity smelted in each set of works, taking my estimate of the weight of each piece, will be about one hundred and six hundred weights; and the nineteen forges, stated in the public accounts to be in this district, and that of Madhu-giri, will yearly produce about one hundred tons of iron, worth nearly one thousand pounds.

For making steel, there are in this vicinity, five forges; four in this district, and one in Déva-Ráya-Durga. To enable the workmen to give them a supply, the merchants frequently make them advances, for almost the whole is exported. It is used for making stone-cutters' chisels, sword blades, and the strings of musical instruments. The furnace (see Figs. 1 and 2) is constructed in a hut *a*, and consists of a horizontal ash-pit, *b*, and a vertical fire-place, *c*, both sunk below the level of the ground, *d*. The ash-pit is about three-quarters of a cubit in width and height, and conducts from the lower part of the fire-place, to the outer side of the hut, where it ends in a square pit, *e*, in which a man can sit, and with a proper instrument draw out the ashes. The fire-place is a circular pit, a cubit in diameter, and descends from the surface of the ground to the bottom of the ash-pit; and at a little distance from the mouth of the fire-place, in order to keep the workmen from the sparks and the glare of the fire, is erected a mud wall, *f*, about five feet high.

Through the bottom of this, passes an earthen tube, *g*, which conducts into the fire-place the wind of two pairs of bellows, *h*. The bellows are, as usual, supported on a bank of earth, *i*, and consist each of a bullock's hide; they are wrought, as in other places of this country, by the workman passing his arm through a leather ring.

Fig. 1.

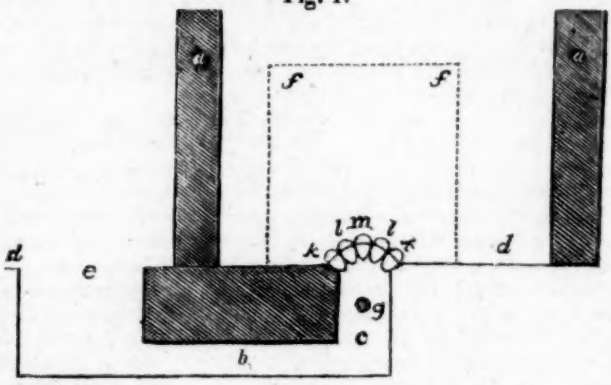
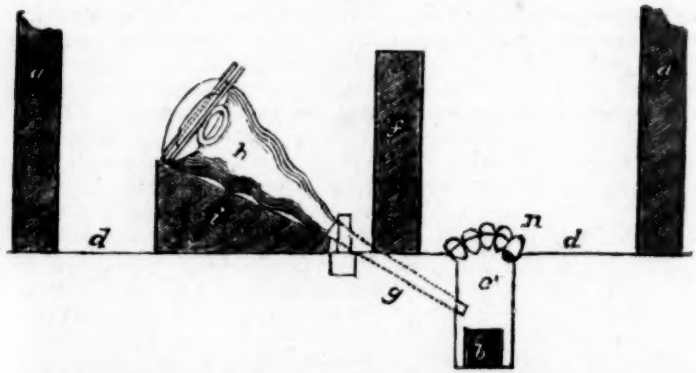



Fig. 2.




The crucibles are made in a conical form, of unbaked clay, mixed with the husks of rice well incorporated together, and each would contain about a pint of water. In each is put one-third of a wedge of iron, with three rupees weight (five hundred and thirty-one grains) of the stem of the *tayngada*, or *cassia auriculata*, and two green leaves of the *hunginay*, which is, no doubt, a *convolvulus*, or an *ipomea*, with a large smooth leaf, but never having seen the flower, I could not, in such a difficult class of plants, attempt to ascertain the species. The mouth of the crucible is then covered with a round cap of unbaked clay, and the junction is well luted. The crucibles, thus loaded, are well dried near the fire, and are then fit for the

furnace. A row of them, *k*, is first laid round the sloping mouth of the fire-place; then, within these, another row is placed, *l*, and the centre of this kind of arch is occupied by a single crucible, *m*, which makes in all fifteen. That crucible in the outer row, *k*, which occupies the place opposite to the nozle of the bellows, is then taken out, and in its stead is placed horizontally, an empty crucible, *n*. This the workman, who manages the fire, can draw out when he pleases, and throw fuel into the fire-place. The fuel used, is charcoal, prepared from any kind of tree that grows in the country, except the *ficus bengalensis*, and the *chloroxylon dupada* of my manuscripts. The fire-place being filled with charcoal, and the arch of crucibles being covered with the same fuel, the bellows are plied for four hours, when the operation is completed. A new arch of other crucibles is then constructed, and the work goes on night and day; five sets, of fourteen crucibles each, being every day converted into steel. When the crucibles are opened, the steel is found melted into a button, with evident marks, on its superior surface, of a tendency to crystallization; which shows clearly that it has undergone a complete fusion. It is surrounded by some vitrified matter, proceeding from the impurities of the iron, and, probably, nearly equal to the quantity of carbon absorbed from the sticks and leaves shut up in the crucible, for the steel in each crucible is, by the workmen, reckoned to weigh one and a quarter *seer*. These buttons, however, are never sold by weight, and those I tried, weighed very little more than one *seer* of twenty-four *rupees*. In some crucibles, the fusion is not complete, in which case, the steel is of a very inferior quality, and differs very little from the common iron.

The number of people employed at one of these works, is thirteen; a head workman, who makes the crucibles, charges them with the materials, and builds up the arch with them; and four reliefs of inferior workmen, each consisting of three persons, one to attend the fire, and two to work the bellows. Each set, therefore, in the working season, labours only four hours in the day, except every fourth day, when they must attend double that time. They are all cultivators, and in the leisure time which they have from the furnace, they manage their fields. There is, also, a proprietor, who advances all the money required, and who receives payment when the steel is sold. Fifteen pagodas' worth of iron is purchased; two for the head workman, and one for each labourer, and for the proprietor. This iron is then given to the head workman, who, for three months, is occupied in making the crucibles, loading them, and preparing the furnace. During this time, the twelve workmen bring him clay, repair the buildings, and make charcoal; but these labours occupy only intervals that could not be employed on their small fields of *ragy*. In the fourth month, when all has been prepared, they convert the fifteen pagodas' worth of iron into steel, as above described. Every man then takes the steel which his iron has produced, and the proprietor is repaid for his advances. Another quantity of iron is then purchased, and the same process is repeated; so that by each fur-

nace, forty-five pagodas' worth of iron is, in the course of the year, converted into steel. Besides the money advanced for iron, the proprietor, for the immediate subsistence of the workmen, is, occasionally, under the necessity of advancing them money; and he must also pay the general expenses attending the forge. These are,

| | Fanams. |
|---|---|
| To the keeper of the forest, for leave to make charcoal | 110 |
| To the *sunca*, or collector of the customs - - | 30 |
| To the *gauda*, or chief of the village, for house rent - | 15 |
| To sacrifices - - - - - - - - - - | 30 |
| To bellows - - - - - - - - - - - | 42 |
| To the brâchmans, as charity - - - - - - | 20 |
| Fanams | 247 |

Every man, however, repays his share of this, in proportion to his quantity of steel; and the whole profit of the proprietor, is the having three pagodas' worth of iron converted into steel, for which he will, in general, be in advance about forty pagodas; he, therefore, requires a capital to that extent, unless he can borrow it from some merchant, which, indeed, he generally does.

| | | |
|---|---|---|
| The forty-five pagodas produce one thousand eight hundred wedges of iron, and on an average produce four thousand five hundred pieces of good steel; which, at two and a half for the fanam, are equal to - - - - - | Fanams | 1800 |
| Nine hundred pieces of bad steel, at six fanams - - | | 150 |
| | | 1950 |
| Deduct general charges - - - | Fanams 247 | |
| Price of iron - - - - - - | 450 | |
| | — | 697 |
| Net gain | | 1253 |

The net gain, twelve hundred and fifty-three fanams, divided by fifteen, gives eighty-three fanams and a half clear profit, for each share. The workman's wages are equal to one share, and thus amount to about seven fanams a month, with double that for the foreman, because he gives up his whole time to the business. These wages are good; but the allowance for the proprietor is small, unless we consider that he, in general, gets the money from the merchant, and that his only claim for reward, is some trouble in settling the accounts, and the risk of some of the people running away with the advances made to them. Among the natives themselves, however, very little danger arises from this cause, as they are perfectly acquainted with the characters of the individuals employed.

Taking the average of the natives, of thirty rupees' weight being the true average of the pieces of steel, the quantity of steel fit for exportation, that is annually made in this vicinity, will be about one hundred and fifty-two hundred weights, and its value about 300*l.*, or 2*l.* a hundred weight.

*On regulating the heat of Furnaces by means of Pyrometers, acted on by radiant heat.* *By* J. M'Sweeny, M. D.

*Cork, September* 6, 1828.

Sir,—To measure the heat of furnaces, has been for a long time a desideratum with scientific men. The subject, latterly, has engaged considerable attention. We have the suggestions of Dr. Ure, of Mr. Daniel, and of Mr. Prinsep. To point out all the advantages that would arise from ascertaining the heat of a body at a very high temperature, would be unnecessary; the importance of the subject is allowed.

The mere practical man, who sees the great discrepancies between the experiments of Mr. Wedgwood and of Mr. Daniel, and between the experiments of the latter and of Mr. Prinsep, to ascertain the relation which the heat of a furnace bears to the scale of the thermometer, is inclined to treat with indifference these attempts; and rests satisfied either with watching the appearance of the fire to regulate the heat, or with employing, merely as a gauge, a rod of metal, which expands, and moves an index. The great objection to the use of pyrometers, at present, is, that they are liable to be injured by the action of the fire, and the bar of a gauge that traverses the centre of a furnace, is liable to be destroyed by intense and long continued heat.

The object of this paper is, to point out an instrument which may be employed by the practical man as a gauge to regulate the heat of his furnace; and which may be also used in experiments to ascertain the relation which the heat of bodies, at a high temperature, bears to the scale of the thermometer.

The instrument consists of a hollow metallic cone, open at each end, and polished inside, and one foot long; the diameter of the base is four inches. The cone is supported in the horizontal position, by small bars of wood, which rise from a board; this board serves as a stand for the instrument, by having a sheet of cork, a bad conductor of heat, fastened at the bottom. From the stand rises a case of wood, in the form of an arch, which covers the cone, but is open at each end; and the space between the surface of the cone and the wooden case is stuffed with wool, a bad conductor of heat. From the case, a delicate thermometer is suspended by thread, so that the bulb lies nearly in contact with the cone; the thermometer is kept from oscillating by other threads, fastened to different parts of the case. When a hot body is placed at a short distance from the base of the cone, it quickly raises the thermometer placed opposite the other end, by the radiant heat.

When the instrument is placed at a certain fixed distance opposite the fire of the furnace, the radiant heat of the fire will affect the thermometer, more or less, as the heat of the furnace is intense or diminished. The standard distance, is two feet from the fuel to the base of the cone; it is to be placed exactly opposite the middle of

the fire. Small boards are to be placed, one on the other, for the stand to rest on, until the desired elevation is acquired.

When a workman has got his fire at a temperature that suits his business, and is desirous of registering, by means of a gauge, the amount of heat, that he may be able to acquire it again on other occasions, he is at first to ascertain the mean temperature of the room, which may be sixty-five; he is then to place the cone at the standard distance of two feet opposite the fire, and to count the number of degrees the radiant heat of the fire raises the thermometer above sixty-five. On any future occasion, when the mean temperature of the apartment is sixty-five, he has only to place the cone as before, at the distance of two feet; and when the thermometer is raised the same number of degrees above sixty-five, as in the former experiment; the advantageous degree of heat required, is obtained. When, from the state of the weather, the mean temperature of the apartment varies, an allowance must be made for the difference. This gauge is not complicated, and is not very liable to get out of order.

In using it as a pyrometer to measure the heat of a fire as compared with a thermometer, let us suppose the mean temperature of the apartment, sixty-five; the cone, upon being used to point out the heat of a brisk fire, is placed at the standard distance of two feet, opposite a plate of iron, red hot; the thermometer will be raised above sixty-five, but will be below the degree that marked a brisk fire. If the plate of hot iron be allowed to cool, until its redness is only visible in the dark, the thermometer will indicate less heat, but greater than that of the mean temperature of the apartment. In like manner, if, at the distance of two feet, we present the side of a vessel containing boiling mercury, opposite the base of the cone, the heat indicated will be less than that caused in the last experiment. If, instead of the mercury, we now present, at the same distance, the side of a vessel containing boiling oil, the heat will be less; and a vessel containing boiling water, will cause a still lower indication by the thermometer; but yet the heat will be greater than that of the room. The excess of heat above sixty-five, is to be carefully marked after each experiment.

Thus the pyrometer is founded on the principle, that the radiant heat emanating from a hot body, will raise the thermometer, placed at a fixed distance, above the mean temperature of the room, in proportion as the body is heated; and that, as it cools, the thermometer will fall in the same relative proportion: and that the number of degrees above the mean temperature of the room, will point out the relative degrees of heat of the hot bodies subjected to experiment.

We know the heat of boiling water, as compared with the heat of boiling oil; and we know the comparative heat of boiling oil, to the heat of boiling mercury. When vessels containing mercury or oil, in a state of ebullition, are placed successively at the distance of two feet opposite the base of the cone, their relative effects on the thermometer are to be carefully marked.

In this way, we may compare the effects on the thermometer, pro-

duced by a plate of red hot iron, with the effects produced by the side of a vessel containing boiling oil or boiling mercury, and may deduce what its comparative heat is, in reference to the heat of these boiling liquids.

Surfaces of different kinds, differ in their power of radiating heat; therefore, the vessels containing the hot liquids, should be of the same kind; and the sides of the vessels, presented to the base of the cone, should be uniform in colour, and in every other respect. The hot body subjected to experiment, should be larger than the area of the base of the cone.

The great difference between experiments made with pyrometers subjected to the direct action of the fire, encourages attempts to arrive at truth, by a different road. Mr. Prinsep makes the melting point of pure silver, four hundred degrees below the determination of Mr. Daniel. The most sanguine in using pyrometers, expect only to approximate towards the real degree of heat.

What the workman is anxious for, is to keep up a steady heat that suits his business, and he will look with a friendly eye on any self-regulating apparatus, that will keep the heat of his fire from rising above, or falling below, a certain point. In a late number of the *Technological Repository*, you have given the French plan for regulating the temperature of apartments; the regulator of the fire is very ingenious; but a more delicate regulator suggests itself, in the form of an air thermometer, on a very large scale. Air, heated, expands equally; therefore, if we enclose a portion of air or gas, at a certain distance from the furnace, it will expand as the furnace is heated.

A very large air thermometer is to be made of copper; the copper bulb is to be fastened at a fixed distance from the fire; a large tube, in the form of the letter L, contains the water, which confines the air in the bulb. On the water in the tube, is a float; this float is connected, by means of a wire, with the end of a lever; the wire rises through a stuffing box at the top of the tube. The other end of the lever is connected by a rod, to the register door of the furnace. The register door turns on a horizontal axis, and is easily moved. The lever, by means of grains of shot, for which there is a receptacle provided, is kept in the horizontal position when the heat of the furnace is at the desired point. If the heat should increase, the air in the bulb expands, and the water rises in the tube; consequently, the float rises, and the opposite end of the lever descends, and shuts the register door.

If, on the contrary, the heat should decrease too much, the air in the bulb contracts, the float descends and pulls down the lever, and, consequently, opens the register door.

By regulating the heat of water circulating in tubes, the temperature of hot-houses and apartments may be kept steady for all useful purposes. You have already suggested, in a late number, a very useful application of the French plan for regulating the heat of apartments; namely, to the rearing of silk-worms in England.

I am, sir, your obedient servant,

To T. Gill, Esq. J. M'Sweeny.

*Remarks by the Editor.*—We have no doubt that some good practical results may be obtained by adopting the suggestions of our worthy correspondent. Possibly a polished concave speculum, which would collect and concentrate the heated rays upon the bulb of the thermometer, might be preferable to the cone. [*Tech. Rep.*

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*Experiments on the Pressure of the Sea, at considerable Depths.* By JACOB GREEN, M. D. *Professor of Chemistry, in Jefferson Medical College, Philadelphia.*

AMONG the various expedients resorted to for the purpose of relieving the tedium and monotony of a sea-voyage, no one is more common during a calm, than to attach to a long line (the log) an empty bottle, well corked, and then to sink it many fathoms in the sea. In all such experiments it is well known, that the bottles, upon being drawn up, are either full, or are partially filled with water. The manner in which the water gets into the bottle, is, in some instances, perfectly obvious, but in others very perplexing, if not wholly inexplicable. Sometimes the cork, however well secured and sealed, is driven into the bottle, and, when drawn up, the vessel is of course, found filled with water; and in such cases, what is a little surprising, the cork is often found occupying its original position in the neck of the vessel, being forced there, no doubt, by the expansion of the dense sea-water, on being drawn near the surface. This seems to be proved by the cork being often in an *inverted* position. In the above experiment, and in some others to be mentioned presently, the bottle appears to be filled instantly; as the person who lowers the bottle, often feels a sudden increase of weight, somewhat similar to the sensation produced, when a fish takes the hook on a dipsey line.

Sometimes the above experiment is varied, by filling a vessel with fresh water, which, on examination, is found to be replaced by salt water; the cork remaining, apparently, undisturbed.

Sometimes, when the previously empty bottle is only half full of water, this, when poured into a tumbler, effervesces like water highly charged with carbonic acid gas. This is readily explained: for when the bottle descends, it is full of air, and when the water enters, it will, of course, absorb the air; especially when the dense water itself expands as it is drawn towards the surface.

Sometimes the experiment is performed by first corking the bottle *tight*, and then tying over the cork a number of layers of linen dipped in a warm mixture of tar and wax; in fact, every device seems to have been tried to prevent the entrance of the water by the cork. In many of these cases, when the bottle is drawn up from a depth of 200 or 300 fathoms, it is found filled, or nearly filled with water, the cork sound, and in its first situation, and the wax and tar unbroken. Two experiments are mentioned, in which ves-

sels with air-tight glass stoppers were used. In one case, the bottle was broken, and in the other, some drops of water were found in it.

How does the water find its way into the bottles? There are two opinions: one is, that it passes through the cork and all its coverings, in consequence of the vast pressure of superincumbent water, in the same manner as blocks of wood are penetrated by mercury, in the pneumatic experiment of the mercurial shower. The other, and less popular opinion, is, that the water is forced through the pores of the glass.

The following experiment, which I made on the 7th of May, 1828, in latitude 48 + longitude 24° 34′, will, perhaps, throw some light on this subject.—Mr. Charles Dixey, the obliging and intelligent master of the packet-ship Algonquin, had a boat rowed off from the ship, for me, to the distance of about half a mile, when the sea was almost perfectly calm. A hollow glass globe hermetically sealed, which I had previously prepared in Philadelphia, was then fastened to a line, and sunk, with a heavy mass of lead, to the depth of 230 fathoms, or 1380 feet. On the same line, and 30 fathoms above the glass globe, was fastened a small bottle with an air-tight glass stopper; 50 fathoms above this, a stout glass bottle with a long neck, was tied; a good cork was previously driven into the mouth of this bottle, which was then sealed over with pitch, and a piece of linen dipped in melted pitch, was placed over this; and when cool, another piece of linen treated in the same way, was fastened over the first. Twenty fathoms above this bottle, another was attached to the line, much stouter, and corked and sealed like the first, except that it had but one covering of pitched sail-cloth. Thirty fathoms above this, was a small thin bottle filled with fresh water, closely corked; and 20 fathoms from this last, there was a thin empty bottle corked tight and sealed, a sail-needle being passed through-and-through the cork, so as to project on either side of the neck.

Upon drawing in the line, thus furnished with its vessels, and which appeared to have sunk in a perpendicular direction, the following was the result:

The empty bottle with the sail-needle through the cork, and which came up the first, was about half full of water, and the cork, and sealing, as perfect as when it first entered the sea.

The cork of the second bottle, which had been previously filled with *fresh* water, was loosened, and a little raised, and the water was *brackish*.

The third bottle, which was sealed and covered with a single piece of sail-cloth, came up empty, and in all respects as it descended.

The fourth bottle, with a long neck, and the cork of which was secured with two layers of linen, was crushed to pieces, all except that part of the neck round which the line was tied; the neck of the bottle both above and below the place where the line was fastened, had disappeared, and the intermediate portion remained embraced by the line. This I thought a little remarkable; but, perhaps, it may be explained by supposing that the bottle was first filled by the superincumbent pressure, with dense sea-water, which expanded on being

drawn up near the surface. Had the vessel been broken by external pressure, that part surrounded with the line, ought to have been crushed with the rest.

The fifth bottle, which had been made for the purpose of containing French perfumery, or æther, and which was, therefore, furnished with a long close glass stopper, came up about one-fourth filled with water.

The hollow glass globe, hermetically sealed, which was the last, and had been sunk the deepest of all, was found perfectly empty, not having suffered the smallest change. It is, therefore, concluded, that at the depth of 230 fathoms, the water enters glass vessels through the stoppers and coverings which surround them, and not through the pores of the glass. What the effect of a pressure of 400 fathoms or more will have on the glass globe above-mentioned, Captain Dixey has engaged to ascertain for me on his return to America, if opportunity shall offer. [*Phil. Mag.*

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## *Account of a new method of projecting Shot, discovered by* Mr. Sieviere.

At a meeting at the Royal Institution in London, held on the 23d of May last, Mr. Brockedon gave some account of a new method of projecting shot, which had been discovered by Mr. Sieviere, the sculptor. Mr. Sieviere had furnished Mr. Brockedon with a report of his earliest experiments, and to some of a later date, Mr. Brockedon was an eye-witness. The discovery was accidentally made many years since, by Mr. Sieviere, who was one evening amusing himself with a pewter syringe, which he had converted into a cannon, having closed the discharging end of the syringe, and made a touch-hole. Into this cannon, he put some pinches of gunpowder, and discharged the piston from it, which fell harmless at a short distance; happening to invert the order of firing, by holding the piston, the syringe was discharged with so much violence, as to pass through the ceiling and floor into the chamber above that in which he sat. He was struck with the prodigious difference of effect produced, and immediately had a shot cast, which, in form, was like a mortar: this he fired from a solid mandrel, or bar swung upon trunnions, and capable of elevation and adjustment. His experiment succeeded so entirely, that he was induced to make a shot with radiant bars, which, though they added little to its weight, added much to its power of destruction to rigging, &c. The weight of this shot, which was of cast-iron, was 15 pounds; this was discharged through a bank of clay 6 feet thick, and fell 20 yards beyond it. When fired again, it hit point blank at a distance of 175 yards, and was buried above 3 feet in the bank; the chamber of this shot, with which a touch-hole communicated, was precisely like that of a mortar, and when it was placed for firing upon the mandrel, the shoulder of the chamber at the bottom of the calibre rested upon the end

of the mandrel. The chamber contained a charge of 1¼ ounce of gunpowder. An experiment was made with a shot which weighed 25 pounds; but a charge of 2¼ ounces of gunpowder was so great as to burst it, and to throw a fragment of 5½ pounds weight, to a distance of more than a quarter of a mile. Subsequent experiments with shot of wrought and cast-iron of different forms, confirmed the fact, that shots discharged with the magazine within them, were projected with a force greatly exceeding that which the same quantity of gunpowder, applied in the usual way, would effect.

Mr. Brockedon attempted to account for this greater force, by supposing that the power usually wasted in the recoil of the gun, was added to the force by which the shot and mandrel were separated. He stated, that no recoil in common gunnery took place, until the shot had left the cannon; and offered the following proofs of this fact. It is a common practice to fire a cannon suspended from triangles: the mark against which it is directed being hit, if any recoil had taken place before the ball left the cannon, the ball must have struck some other point tangential to the circle which its point of suspension would describe. Mr. Brockedon mentioned, that Mr. Perkins, in the course of some experiments upon recoil, had fastened a loaded rifle barrel to the edge of a horizontal wheel, which moved freely upon a vertical axis; the rifle was directed, and hit the mark, though the recoil whirled the rifle and wheel round with great velocity. Mr. Brockedon illustrated this further, by supposing a boat on still water, and imagining a plank placed from stem to stern, and a man on it pushing with a pole, a bundle of hay from him along the plank, the separation of the hay from the man, could not affect the situation of the boat on the water, whilst the hay was on board; but if the hay were thrust over, the moment it became independent of the boat, the man and boat would separate from the hay, with forces proportioned to their densities.

The space required to contain the products of the combustion of gunpowder, has not been determined by careful experiments, but vaguely stated by some, at 500, by others, at 1000 times the volume of the powder; taking the lowest statement, and supposing a cartridge to be six inches long, and the length of the gun to be five feet, not more than about 10-500 of the force generated by combustion, operate upon the ball: the remaining 490-500ths are wasted upon a recoil, which, overcoming the vis inertiæ of the gun with its carriage, (which weighs between three and four tons for a 24 pounder,) will drive it back, in garrison service, against an inclined plane 18 inches, or two feet. The instant the ball leaves the gun, the recoil takes place, and the products of combustion, which remain within the gun in a highly condensed and heated state, are opposed, in their escape, by the vis inertiæ of the external air from which the gun recoils. If recoil were attempted to be explained, simply upon action and re-action, by the intervention of a force separating two bodies, whose resistances were as their densities, then the recoil would prevent any certainty of striking the point or mark against which the cannon is directed; contrary to the effect proved by firing

from triangles, Mr. Perkins's experiments, and the practice of every sportsman. The recoil, too, takes place, whether the firing be with blank or ball cartridge; if the recoil be greater with a ball, it arises merely from the resistance which this offers to the discharge, allowing time for the more complete ignition of the gunpowder, and the generation of a greater force; hence, also, the effect of a rifled barrel, and the recoil of a foul gun.

The sky-rocket illustrates, also, this theory of recoil. To increase the surface of the composition exposed to combustion, the rocket is bored conically, nearly to its entire depth, the products of this combustion are met by the atmosphere as they rush from the neck of the rocket, and recoil from the resistance; as the cone enlarges, the force increases, and accelerates the ascent of the rocket, poised and directed as it is by the rod. The difference between the effects of the rockets and the shot, is, that in the former, the force increases from the gradual but increasing surface in combustion; in the latter, the force is at once generated, and the aid to the force which separates the shot from the mandrel, is greatest at first, and, though gradually lessening, always adds something to the force of the discharge, until the air within the calibre is equalized with the atmosphere.

The father of the late sir Wm. Congreve, tried some experiments with shot fired from a mandrel; but as he bored the mandrel into which the discharge was put, and did not put the magazine in the chamber of the shot, they failed.

As the expense of trying experiments with Mr. Sieviere's engines, is too great for an individual to incur, the probability of its becoming a most destructive engine in warfare, ought to recommend it to the serious attention of government. The advantages of the lightness of the mandrel, and the unlimited weight of the projectile, are immense. When the experiment was made with the 25 pound shot, an invalid watchman carried the cannon shot and ammunition upon his head to Primrose Hill, before breakfast; and the safety of the engine to those employed in its use, may be shown in the fact, that the shot which burst did no injury to the gunner; and no mischief could happen: for if the shot burst without advancing from the mandrel, the fragments dispersed at right angles, and if with any projection, in lines resulting from the united forces, leaving the gunner in safety. The recoil of the mandrel is very small, and arises only at the moment of separation from the pressure of the gases, which, escaping from the calibre, presses upon the end of the mandrel with effect proportioned to its surface. [*Quarterly Journ.*

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*On the Origin of Air Balloons.* *By* G. Cumberland.

Sir,—It is rather remarkable, that so many books having been published on the subject of balloons, and so much money expended in useless experiments, to discover a method of guiding them with

precision, no one that I know of has as yet pointed out *the origin* of the invention, which will be found, copiously detailed, accompanied by a figure explanatory, in a folio volume, dedicated to Leopold I. by *Francesco Lana*, a Jesuit of Brescia; and published by Rizzardi, of Brescia, MDCLXX. The principal part of this volume is taken up by eight chapters on the subject of telescopes and microscopes, in which he gives directions for grinding lenses, and reflectors of metal, with plans to give the true hyperbolic, elliptic, and parabolic curves, the latter of which is extremely ingenious, and shows how well all this part of the business was understood in Italy, some years before sir Isaac Newton sent in his first papers on the subject, to the Royal Society. There are twenty plates of his own engraving, in outline only, except No. 2, on which he has given a feebly shadowed representation of his favourite invention, the aerial ship, with its four balloons, its mast, and sail; but, as the book must be very scarce, it not having been noticed by either *Fontanini*, or Apostolo *Zeno*, or found in the *Floricel* catalogue, I may as well give you the title at length, which is as follows:—

"*Prodromo*—overo saggio di alcune inventioni nuove permesso all' *arte Maestra*—opera chez prepara H. P. Francesco Lana, *Breccian.* Della compagnia di Giesu, per mostrare li più riconditi principij della naturale Filosofia, riconosciuti con accurata Teorica nelle piu segnalate inventioni, ed isperienze sin' hora ritrovatè da gli scrittori di questa materia, et altre nuove dell' autore medesimo.—Dedicato alla sacra Maestra Cesarea del Imperatore Leopoldo I.—In Brescia, MDCLXX."

The book is beautifully printed in small folio, and has a preface of seventeen pages, on the subject of the state of the sciences in his day, and the necessity of adopting the experimental mode in natural philosophy. Of course, like all the writers of that period, he is verbose, but, in many respects, very interesting, and, in general, very rational and ingenious. We will now, however, lay aside all criticism, and relate what he writes on the subject of his *balloon vessel*, which is the most remarkable novelty in his book.

After having, in his fifth chapter *of mechanic inventions, to cause birds to fly through the air*, spoken of *Architus's* dove; Baptista Porta's *flying dragon;* the relation of *Aulus Gellius* in his tenth book of the Aldic Nights; *Regiomontanus's* famous *eagle*, which flew to Charles V. on his entrance into Nuremburg; *Boetius's* narration of certain copper birds, which not only flew, but sang; *Glicas's* relation of other similar birds, which belonged to the emperor Leo; and *Vamiano Strada's* account of those which *Tariano* made for Charles V. to amuse him in his retirement,—he goes on to give the rationale of such contrivances, by four different modes, all very plausible; and then, in his sixth chapter, the title of which is, *How to construct ships, which shall be sustained only by the air, and be conducted by means of a mast and sail—the practicability of which is demonstrated*, he thus proceeds—

"The human intellect is not satisfied with the above inventions, but proceeds to improve on them by a method, by which *men*, like birds, should fly in the air; and, probably, the story of *Dædalus* may not be fabulous, since we are told, as a certainty, that a person (whose name I do not remember) in our times, by a similar method, passed across the lake of Perugia, and afterwards, in attempting to alight on the ground, let himself descend with such impetuosity, that it cost him his life. No one, however, has, hitherto, thought it possible to fabricate a ship to pass through the air, as one does that is sustained by the water, since it has been judged to be impossible to construct a machine lighter than the air itself, which would be necessary to produce the desired effect.

"Hence, I, whose genius ever led me to recover difficult inventions, after long study, conceive that I have obtained my object of constructing a machine lighter than air, which, not only by its own levity, can sustain itself in air, but be capable of supporting men, and any given weight; neither do I fear to be deceived, since the whole can be demonstrated by certain experience, and by an *infallible demonstration* from the 11th book of *Euclid*, received as such by every mathematician. Let us, therefore, lay down certain propositions, from whence may be deduced a practical method of fabricating such a vessel, which, if it does not merit, like that of Argus, to be placed among the stars, will, of itself, be able to sail towards them."

He then proceeds to describe in what manner he found the weight of the air, by a method then in use, and which is, afterwards, more fully detailed, when describing the practical part of his machine; and after going through a long series of calculations, founded on the principles laid down by *Euclid*, in his 11th and 12th books, to prove that the superfices of a ball or sphere, increases in the duplicate ratio of its diameter,—as, for example, that a globe whose diameter is double that of another—say, one of one foot, and another of two—the superfices of the globe of two feet, will be four times as large as that of one, and that the solid body of the globe, if two feet increased in a triplicate proportion, will be eight times as large, and, consequently, eight times as heavy as a globe of one foot diameter; so that the superfices of the larger, over the smaller, will be as four to one, and the solidity, as eight to one. All of which may be easily proved by experience, of which he gives numerous examples in his own experiments with glass globes filled with water, or divested of the air; and then proceeds to calculate, to what dimensions *copper globes* may be made, light enough to weigh less than the air they are capable of containing; and comes to the conclusion, by figures, that they may be conveniently made to contain 718 lbs., and that when the air is extracted, they will weigh 410 lbs. $\frac{1}{4}$ oz. less than before, and, consequently, be capable of lifting two or three men. His method of procuring the vacuum, is as follows:—he fills his globes of copper, resting on a stage, with water, by means of a plug at the top, and, by opening a stop-cock, lets it out through a *long* tube, into a vessel of water below, and, unscrewing the tube,

his globe is in a condition to ascend, but is restrained by cords; and four or more of these globes are bound together, according to the weight of the vessel to be elevated from his *balloon;* to which is attached the boat, furnished with a mast and sail, capable of being turned in any direction, which is to be accommodated with an anchor, also, when proposed to be stationary.

And now, says the author, "I can hardly help smiling to myself, to think that it seems to be a fable not less incredible than that which issued from the voluntary and wild fancies of the head of Lucian; while, on the other hand, I know that I have not erred in any of my proofs, having conferred on the subject with numerous well-informed men, who could not discover any errors in my calculations, and who only desired to behold the experiment, and see the vessel ascend; which I would willingly have gratified them with, previously to publishing my invention, *if the religious poverty I profess, had permitted me to expend one hundred ducats, which would be more than enough to satisfy a curiosity so agreeable.* Hence, I must request any of my readers who may be induced to try this experiment, to favour me with an account of their success; since, should any errors be committed in the operation, I may be able to correct them; and, in order to incite others to the trial, I will here resolve such difficulties as may be opposed to the practical operation of this discovery."

He then proceeds to state a safe mode of exhausting the air; and remarks, that some persons may suppose that, from the violence of the rarefaction, the balloon may either be broken, or so bent, as to destroy its rotundity; but, in answer to this objection, he replies, that the globes, being perfectly spherical, the air will compress every side alike; so that it is more likely to strengthen, than collapse them, as his experience taught him with glass globes, which, when not round, were easily destroyed by the egress of air; but when perfectly so, then they resisted all pressure. Next, he proposes, in order to be secure of this form, that they shall be constructed, first, as two half globes, and then soldered up as one balloon. Again, with respect to the question as to what height this vessel may ascend, since, if they could be raised to the surface of our atmosphere, it naturally follows that the men in it would not be able to respire?—to this he replies, that it could only be supported at a certain height, where the atmosphere was sufficiently dense to sustain it, and that she may be loaded according to the altitude intended to sail in; and would have the power to decline, by merely opening the key of the valve, so as to introduce a certain quantity of common air, and thus they could, at any time, descend.

Again, it might be objected, that she could never sail in any fixed direction, as ships do, who have a resistance from the water; but, says the author, "although air does not resist like water, it still makes some resistance, and if it has less than water, there is less to overcome in sailing; and, as there is always some wind, however weak, there will, probably, be always enough to propel the vessel; and with respect to its being contrary to the course they mean to

keep, he has a contrivance to allow the mast to rotate with its sail in all directions."

Lastly, it may be objected, says he, that it will be difficult to overcome the violence of the wind, which may drive them against the mountains—those formidable rocks in this ocean of air, which might overset them; but here, like all sanguine inventors, he finds an easy answer, which is, that the four globes being above the navigators, they must always be a counterbalance, and until atmospherical air is let in, they need never fear to touch the earth.

"And now," says he, "I can see no other difficulty to putting in practice this invention, except one, which is greater than all the rest; and that is, that God would never permit such a machine to succeed in practice, as it would disturb the civil and political government of the world! For who does not see that no city would be secure from surprise, as these vessels would have the power to place themselves directly over their public places, and thus enter them?" And here he gets heated with horror of the fatal consequences of his new invention, and talks of their cutting ships' cables, throwing down darts, and burning navies, by artificial fires and balls, bombs, &c. killing men, and destroying cities and castles, since, by their height, they might contrive to precipitate mischief on others, whilst they remained secure themselves." In a word, the good friar, like Uncle Toby, seems really alarmed, at last, with his own discovery; and I should not wonder if the scarceness of his folio was occasioned by his withdrawing it from general view, at last, lest he should be the author of so much mischief to mankind. [*Ib.*

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*Abstract of a Memoir read before the Wernerian Society, giving an account of Experiments directed to ascertain the Principles of Attraction and Repulsion in the Lunar Rays, &c.; a Description of several Varieties of the instruments constructed for that purpose; and some Applications of the Observations made, as illustrative of other Subjects.* By MARK WATT, Esq. Member of the Wernerian Society, &c.

THIS paper commenced by some remarks on the unsuccessful attempts that had been made, to determine whether the lunar beam had any calorific properties or not. And, laying this subject altogether aside, the author considered it more probable, that he might succeed in exhibiting, with sufficient certainty, the attractive influence of the moon; a principle which it was generally acknowledged to possess, from the coincidence of its monthly revolutions, with the flux and reflux of the sea. The received calculation also being, that the attractive power of the moon upon our globe, when contrasted with that of the sun, was as 10 to 3, from her greater approximation to the earth.

The different forms of the instrument used for making observations on the attracting and repelling powers of different degrees of light, were constructed on the same plan, with a view to the greatest specific lightness, and the least possible friction, that *motion* might be produced by the most delicate impulses of light.

About 6 inches of the opaque part of the quill of any feather of a suitable size, was used as a balancing bar, which was made to revolve on a fine steel point, by means of a small agate capsule inserted into an aperture made in the quill, at about $\frac{1}{3}$d of the length of the bar from the point to which the disks were attached. No fixture was used for the cap, the elasticity of the medullary part of the quill holding it with sufficient firmness. The disks being affixed to one extremity of the quill, were balanced by any small weight at the other, and they traversed like a compass-needle.

The following substances were tried: A circular piece of dark coloured velvet, about 4 or 5 inches diameter, stretched on small quills; having 25 grains weight of magnetic steel-filings rubbed over its surface. Two, or four, of the illuminated tops of the smaller caudal feathers of the peacock (Pavo cristatus), with their dingy sides (which are little attracted by light) applied to each other, formed another kind of disk. Their planes were placed perpendicularly, and they were stuck into the end of the revolving quill. They were formed into a convenient size, by cutting off the straggling filaments of the feathers. One disk was made of gold, and another of silver leaf. They were formed by bending a piece of very fine silver-wire, of about the thickness of a hair, into a circle of three or four inches diameter. The wire, after being attached by its edge to the end of the quill, was wetted by a little water, in which a small portion of gum arabic was dissolved. The circle was placed upon a leaf of the gold or silver which adhered to the wire, and the corners of the leaf were then cut off.

The other substances were gold-beaters' skin; very thin paper, coated with lamp-black; and thin laminæ of mica.

All these were successively put under a hemispherical glass-cover, placed upon a marble slab, and secured from any current of air, by being surrounded at the edge by a layer of wax or putty. The effect of light was also tried upon them under the exhausted receiver of an air-pump.

*Effects of the Light of a Candle.*—The first experiments made upon these bodies, to ascertain in some measure how far they were affected by the attracting or repelling influences of light, were by the flame of a candle; all other sources of partial light or heat being excluded.

The velvet disk, with the steel-filings, rendered magnetic, moved to the light of a candle at the distance of 1 foot from the edge of the cover. It turns its edge to the source of light, and consequently its plane nearly parallel to the rays.

The disks made of the feathers were moved by the candle at the distance of 3 and 4 feet, measuring from the flame to the point of suspension. A broad caudal feather of any of the gallinaceous tribe,

if suspended by a fine filament of silk from the top of the cover, and balanced horizontally, with its flat sides opposite to the sides of the cover, will indicate the attractive power of the light at the distance of from 4 to 6 feet. They also traversed 5° either way to the influence of a powerful horse-shoe magnet, when placed so as to rest against the glass, the hand being quickly withdrawn.

The feathers generally begin to move slowly; in a few seconds they uniformly turn the points of their filaments toward the source of light, their sides being parallel to the direction of the rays; and whenever they assume this relative position, they rest. If the flame is placed opposite to the tips of the feathers at once, they move little, or not at all. If the rays of light are made to fall upon their planes, at angles of 40°, 90°, or 150°, they will traverse only to the extent of these degrees, and then remain stationary.

The gold-leaf, for the first hour or two after it is formed into a disk, and put under the cover, shows extraordinary sensibility to the influence of light. It indicates the effects of the light of a candle at the distance of from 15 to 20 feet from the flame. If not kept in the dark, and *in vacuo*, it soon loses this susceptibility; and, in six or eight hours, will not move at a greater distance from the flame than two feet.

The gold-leaf always turns the edge of its disk to the light, in whatever position the candle may be placed.

The silver-leaf is equally sensitive to the impules of light, and never loses this property to the same extent as the gold. If thoroughly dry, and placed *in vacuo*, it indicates the influence of light, when 20 and 25 feet distant from the flame of a candle. Several of the leaves tried, whether kept *in vacuo* or not (if preserved from the light,) when exposed to the attractive and repulsive properties of the rays issuing from the flame of a candle, always moved toward the light, at a distance of eight and ten feet. The silver-leaf has a movement peculiar to itself. It first turns the front of its disk, and then its edge; and this movement is often so constant that it will oscillate for hours in an arc of 90°. When it has lost part of its susceptibility to the impressions of light, it is so attracted as to move till its disk *confronts* the source of the light. In this state, it loses its vibratory motion, and takes a minute or two to traverse 45°.

The gold-beaters' skin moves at the distance of six feet from the flame. It turns its edge to the point from which the light emanates, and then rests.

Very thin paper, coated with lamp-black, or gilded with gold or silver-leaf, and varnished with spirit of turpentine, when the disk is about five inches diameter, moves, by the influence of the light of a candle, at the distance of three and four feet.

As the light passed through the glass of the cover, which would intercept any degree of heat, whilst it admitted the light, and as the movements begin generally in a few seconds, there is no reason to believe that any increment of heat can have any share in producing the motions.

All these bodies, however, move to the influence of heat, when it

proceeds from a *given point*, at various distances. Yet the effect of heat is evidently very inferior, in point of power, to the influence of light.

A piece of coal, for example, two inches square, ignited to a red heat, when presented to the velvet disk, with the filings, only excites it to move towards it, though held close to the cover; but if it is exposed to the clear rays of the sun, during summer, as soon as it has absorbed a certain quantity of the rays, it is strongly repelled, and will continue, when first made, to revolve for hours without intermission, performing each revolution in about 5″. They all turn their edges to the point from which the heat proceeds.

*Effects of the Lunar Beam.*—As the candle used in trying the effects of light on these bodies was of a moderate size, and as there appeared to be little difference between its illuminating power, at 15 or 20 feet from the flame, and the light afforded by the moon, when nearly full, it did not appear to the author unreasonable to expect, or surprising to find, that the disks were affected by the influence of the lunar rays, in nearly a similar manner. They were made the subjects of experiment both in the open air, under the cover, and in a room with the windows shut. When tried in an apartment, the window was darkened, and they were made to rest (by moving the stand a little,) in such a position that the rays of the moon, when admitted, fell upon the disks nearly at right angles to their planes. They all turned their edges toward the luminary, and their planes nearly parallel to the incidental beams; and they frequently maintained this relative position for hours, moving slowly and regularly, by following the moon's apparent course, like the shadow of the gnomon of a dial.

The silver-leaf only continued a vibratory movement, but the arcs of vibration were evidently regulated by the position of the luminary in the hemisphere.

The movements of the feathers, and of the disks made of the gold and silver-leaf, are the most constant and decided. The tips of the feathers are always attracted to the moon. And they have frequently been observed to commence their motion a few seconds after the beam has been allowed to fall upon them, in whatever angle their planes may have been resting, in relation to the incident ray. They have traversed, occasionally, 170° in a minute; and when the tips of the feathers came nearly opposite to the satellite, they stopped. It is only those feathers of the peacock that have a greenish hue when we look down upon their surfaces, that seem to be most attracted to the light of the moon. Those feathers where the bright purplish colour prevails, evince a more uncertain effect. These instruments will stand for hours in a room without moving, if placed in a situation where the beams do not impinge upon them.

These experiments have been often repeated, as opportunities occurred, for the last six months, and with every possible precaution. And there appears to be the greatest powers of attraction and repulsion in the moon's influence, from the time she has completed her first octant, till she is in quadrature or gibbous. There seems

less attraction when she is full, and this may arise from the moon's being then in opposition, and the light must be reflected from it at that time almost directly against the light of the sun; whilst, when passing through her other phases, her reflected light will cross the light of the sun at acute or right angles.

It is not mere motion that has been observed in these instruments, but a movement evidently regulated by the source from which the light is emitted.

In performing these experiments, attention must be paid to the following circumstances: The cover used should be large, thin, and purely transparent; a card should be placed in the centre of the stand, divided into quadrants and points, to mark the progress of the revolving bar; regard must be had to great specific lightness, and the disks must be kept perfectly free from damp. Care must be taken, also, that the capsule is fairly placed on the pivot, which ought to be very fine. Every source of partial light and heat ought, as far as possible, to be excluded. And the instruments must be kept covered from the light some hours before they are used, as they will not move to a subdued degree of light if they have been exposed to a greater. Their sensibilities are considerably blunted for a time, if exposed to powerful light. We must also keep at some distance from the instrument when making the trials, as the heat and electricity that escape from our bodies are a source of attraction. All these bodies are much influenced by the solar beam. But nothing yet observed, if used in *equal weights*, moves so regularly as the magnetic steel to the sun's influence, which is affected in a way peculiar to itself.

Two causes are assigned for the phenomenon, that all bodies of sufficient specific lightness, having two flat sides approaching to planes, and free to move, turn always the edges of their planes to the source of light, and their planes parallel to the line of incidence. One of the causes appears to be a sort of elective attraction, which light, like electricity, has for the points or edges of bodies. The other reason is, that all bodies kept excluded from light, are, when exposed to it, first attracted by it; and when, from their colour or opacity, they have absorbed a certain quantity of the rays, are then repelled by it. The rays of the sun evidently soon repel all the substances mentioned; and when they turn their edges, they are in that position where they receive the least possible impulse from the rays. As a vane is turned by the mechanical force of a current of air, these instruments are turned by the repelling power of the beams of light. Bodies, quite transparent, are not taken into the account. The silver-leaf is a half exception to this general law, but it is almost colourless and polished, and therefore absorbing but a small portion of the light, and quickly parting with it; it assumes a vibratory motion, first turning its plane, and then its edge, to a strong light, and thus continually moving in the arc of a quadrant. To a feeble light it stands with its plane confronting it.

The motion of the feathers seems chiefly to be occasioned by attraction. And as each filament of a peacock's feather of the size used,

has about 4000 piles upon it, each disk, at a moderate calculation, would present about a million of points to the light. These facts agree with some principles generally received, as establishing many coincidences between the phenomena of light and electricity.

Some farther observations were made on the effects of the rays of light on bodies of different forms. While bodies having planes, turned their edges towards the source of the light, and their flat sides parallel to the line of incidence, bodies of a concave shape vacillated continually in an arc of from 5° to 45°, according to the intensity of the beam of light. Bodies of a cylindrical form, crossed the line of incidence at an angle of about 25°. Transparent lenses (as of amber) keep their axes parallel with the incidental rays. And spherical opaque bodies, when nicely suspended or balanced, have the tendency to revolve continually when the beams of the sun fall clearly upon them.

Some applications were made of the phenomena described, as farther elucidating facts already known, as the attraction of the leaves and petals of plants to the light,—the formation of crystals,—the knowledge that birds and quadrupeds seem to possess of the cardinal points, as probably arising from the sensibility of their hairs and feathers to the impressions of light, electricity, and magnetism, and through them to the nervous system and sensorium. As farther explanatory of the polarity of the needle if any current of magnetism is allowed to exist, and of the diurnal variation of the pointing and dip, as dependant on the motions of the sun; and from the principle that light attracts bodies or the parts of bodies that have been in the shade, and repels that which has been for some time exposed to its influence, producing by this means a continual revolution in bodies of a spheroidal form; it is thought probable that this may be one cause of the diurnal rotation of the earth and the planets.

It has not been observed that any of these bodies indicate the electrical changes of the atmosphere; because the changes in respect to them must be general, or affecting each part of them equally. The silver-leaf, indeed, has sometimes a curious vibratory motion; but these vibrations are evidently regulated by any beam of light falling on the disk. Two of the disks suspended on two pivots, and opposed to each other, would no doubt act as an electroscope.

*Jameson's Journal.*

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## *Notice in regard to the Jaculator Fish of Java, or Chætodon rostratum*, Lin. By James Mitchell, Esq. Surgeon, R. N.

Whilst residing in the island of Java, in December, 1822, I heard of an extraordinary species of fish, in the possession of a Javanese chief, who lived within a mile of the town of Batavia.

Accordingly I went to see it, in company with Mr. Johnson, the commander of the ship Guilford, in which I was a passenger, and with an interpreter.

On our arrival at the chief's villa, we were treated by him with great courtesy. After conversing with him some time he permitted us to visit his gardens to see these fish, upon which he placed a high value, and would on no account part with one of them.

The fish were placed in a small circular pond, from the centre of which projected a pole upwards of two feet in height. At the top of this pole were inserted small pieces of wood, sharp pointed, and on each of these were placed insects of the beetle tribe. The placing of this pole and insects by the slaves had disturbed the tranquillity of the fish, so we had to wait some considerable time before they began their operations; but this delay was amply recompensed by the amusement they afterwards afforded us. When all had been tranquil for a long time, they came out of their holes, and swam round and round the pond. One of them came to the surface of the water, rested there, and after steadily fixing its eyes for some time on an insect, it discharged from its mouth a small quantity of watery fluid, with such force and precision of aim, as to force it off the twig into the water, and in an instant swallowed it.

After this, another fish came and performed a similar feat, and was followed by the others, till they had secured all the insects. I observed, that, if a fish failed in bringing down its prey at the first shot, that it swam round the pond, till it came opposite to the same object, and fired again. In one instance I observed one of these animals return three times to the attack before it secured its prey; but, in general, they seemed to be expert gunners, bringing down their prey at the first shot.

I was informed that these fish were originally imported from China, and are now the only specimens alive in Java, although about fifty years ago they were in possession of several of the Javanese chiefs. I could not learn their proper name; the only one that I heard was the usual term for fish made use of by the Javanese, viz. "Icon."

From the view we had of them, which was only in the water, they appeared short, about five or six inches in length, rather flat in the body, with blackish stripes variously interspersed.

The slaves of this chief fed the fish with insects regularly twice a day, in the manner I have described.

This appears to me a novel species of instinct implanted in these animals by the wise author of nature, enabling them to secure their prey, by shooting, in this manner, those insects that should happen to rest on any of the aquatic plants growing in the ponds they inhabit, and placed by their height out of their reach.

When they eject the water from their mouths, it is attended by a noise like one spitting, or squirting with a syringe.

As I had no opportunity of examining these fish, I could not say whether the fluid they squirted from their mouths was the product of secretion, or merely the water from the pond.* [*Ib.*

* The first account of this fish was published in the Transactions of the Royal Society of London, vol. liv. p. 89. It is contained in a letter to Mr. P. Collins, F. R. S. from J. A. Schlosser, M. D., F. R. S. The following is an ex-

## *On the Spontaneous Combustion of the Human Body.*

On the 12th of May, 1828, M. Julia Fontenelle read, in the academy of sciences at Paris, a memoir entitled, *Recherches Chimiques et Medicales sur les Combustions Humaines Spontanées.*

The observations which form the subject of this memoir are highly deserving of attention. In fact, besides the interest which they are capable of exciting from their very nature, they afford a new example of one of those phenomena, the existence of which has, in these later times, been questioned, solely because, while they are very singular and difficult to be accounted for, they are also of such rare occurrence, that they can only be authenticated by an aggregate mass of evidence, which evidence, although sufficient to induce conviction, may always be rejected by those who are prejudiced, or who do not give themselves the trouble of duly estimating their value.

Are there really spontaneous combustions of the human body?

tract from the letter: "Governor Hommel* gives the following account of the jaculator or shooting-fish, a name alluding to its nature. It frequents the shores and sides of the sea and rivers in search of food. When it spies a fly sitting on the plants that grow in shallow water, it swims on to the distance of four, five, or six feet, and then, with a surprising dexterity, it ejects out of its tubular mouth a single drop of water, which never fails striking the fly into the sea, where it soon becomes its prey.

"The relation of this uncommon action of this cunning fish raised the governor's curiosity; though it came well attested, yet he was determined, if possible, to be convinced of the truth, by ocular demonstration.

"For that purpose, he ordered a large wide tun to be filled with sea-water; then had some of these fish caught, and put into it, which was changed every other day. In a while they seemed reconciled to their confinement; then he determined to try the experiment.

"A slender stick, with a fly pinned on at its end, was placed in such a direction, on the side of the vessel, as the fish should strike it.

"It was with inexpressible delight that he daily saw these fish exercising their skill in shooting at the fly with an amazing velocity, and never missed the mark."

Then follows Linnæus's description, taken from his work of the Museum of the king of Sweden, printed in 1754, where it bears the name of *Chætodon rostratum.*

In vol. lvi. p. 186, there is a farther account of the habits of this fish, in a letter from Mr. Hommel: "When the jaculator fish," he says, "intends to catch a fly, or any other insect, which is seen at a distance, it approaches very slowly and cautiously, and comes, as much as possible, perpendicularly under the object: then, the body being put in an oblique position, and the mouth and eyes being near the surface of the water, the jaculator stays a moment quite immoveable, having its eyes directly fixed on the insect, and then begins to shoot, without ever showing its mouth above the surface of the water, out of which, the single drop, shot at the object, seems to rise. No more than two different species of this fish are found here." The first is that already mentioned, as described by Linnæus, under the name Chætodon rostratum, and to which all the above refers. The other is described by Dr. Pallas, under the name of *Sciæna jaculatrix*, p. 187, of the same volume. Both species are figured.—EDITOR.

* Mr. Hommel, governor of the hospital at Batavia.

Such is the first question which the author examines, and he resolves it by the affirmative. Fifteen observations of spontaneous combustions, which he successively relates, enable him not only to establish the incontestible reality of the phenomenon, but also to make known the principal circumstances which accompany its manifestation. In summing up these circumstances, he remarks:

1. That persons, who have been destroyed by spontaneous combustion, have, for the most part, been immoderately addicted to the use of spirituous liquors.

2. That this combustion is almost always general, but that it may be only partial.

3. That it is much rarer in men than in women, and that the women in which it has been manifested, have almost all been aged; one woman only was seventeen years of age, and in her the combustion was but partial.

4. That the body and viscera have always been burnt, while the feet, the hands, and the top of the head, have almost always escaped.

5. Although it is demonstrated that several loads of wood are necessary for reducing a dead body to ashes by ordinary combustion, incineration is effected in spontaneous combustions without the most combustible objects placed in the vicinity being burnt. In one case there was a very singular coincidence of two persons being consumed at the same time, in the same apartment, without the apartment or the furniture being burnt.

6. It is not demonstrated that the presence of a burning body is necessary for producing spontaneous combustion of the human body; on the contrary, there is every reason to believe the reverse.

7. Water, so far from extinguishing the flame, seems to render it more active; and after the flame has disappeared, the intimate combustion continues to be effected.

8. Spontaneous combustions have appeared more frequently in winter than in summer.

9. No remedy has been found for general combustion, but only for partial.

10. Those who undergo spontaneous combustion, are the prey of a violent internal heat.

11. Spontaneous combustion developes itself suddenly, and consumes the body in a few hours.

12. The parts of the body which are not consumed by it, are attacked with sphacelus.

13. In individuals affected by spontaneous combustion, there supervenes a putrid deterioration, which presently brings on gangrene.

14. The residuum of spontaneous combustion consists of greasy ashes, and an unctuous soot, both having a fetid odour, which diffuses itself equally through the apartment, impregnating the furniture, and extending to a great distance.

The author then explains the two theories of combustion, between which, the learned world is at present divided; Lavoisier's, and that lately proposed by Berzelius. He then gives an account of the theories proposed for the explanation of the phenomenon in question.

Most authors, who have spoken of spontaneous combustions, have imagined they discovered an intimate relation between their manifestation and the immoderate use of spirituous liquors in the individuals attacked. They suppose that these liquors, being continually in contact with the stomach, penetrate through the tissues, and fill them up to saturation, in such a manner that the approach of a burning body is sufficient to induce combustion in them.

M. Julia Fontenelle, does not consider this explanation satisfactory. He founds his opinion, 1st, on the circumstance that there is no proof of this alleged saturation of the organs in persons addicted to the use of spirits; 2dly, on the circumstance that this saturation itself, would not suffice to render the body combustible,—and, to demonstrate this assertion, he gives the result of several experiments, in which he in vain tried to render ox-flesh inflammable, by steeping it for several months in brandy, and even in alcohol and ether.

Another explanation has been proposed. Dr. Marc, and with him several other physicians, from the development of hydrogen gas, which takes place in greater or less quantity in the intestines, have been led to imagine, that a similar development may take place in other parts of the body, and that the gas might take fire on the approach of a burning body, or by an electrical action produced by the electric fluid, which might be developed in the individuals thus burnt. According to this theory, MM. Lecat, Kopp, and Marc, suppose, in subjects affected by spontaneous combustion, 1. An idio-electric state; 2. The development of hydrogen gas; 3. Its accumulation in the cellular tissue.

This latter explanation would appear to be confirmed by a very curious observation of M. Bailly's. That physician, on opening, in the presence of twenty pupils, a dead body, over the whole of which there was an emphysema, which was greater in the lower extremities than any where else, remarked, that, whenever a longitudinal incision was made, a gas escaped, which burned with a blue flame. The puncture of the abdomen yielded a stream of it more than six inches high. What was very remarkable, was, that the gases contained in the intestines, so far from increasing the flame, extinguished it.

M. Julia Fontenelle, for reasons similar to those which induced him to reject the first hypothesis, is of opinion that the presence of hydrogen gas cannot be admitted as the cause of spontaneous combustion. He founds this opinion more particularly upon experiments, in which he in vain tried to render very thin slices of flesh combustible, by keeping them for three days immersed in pure hydrogen gas, in percarburetted hydrogen gas, and in oxygen gas.

Lastly, he considers the opinion equally untenable, that spontaneous combustion of the human body, is owing to a combination of animal matter with the oxygen of the air, whatever may be the alterations which this matter may undergo: 1. Because a sufficient temperature is not developed; 2. Because, admitting this combustion as real, the residuum would be a charcoal, which could only be incinerated at a red heat, while, on the contrary, there is nothing but

ashes; 3. Because one of the products of spontaneous combustion of the human body, is an unctuous substance, which the combustion of animal substances never yields; 4. Because it scarcely yields any ammoniacal products, while such are always produced by animal combustion.

After thus rejecting all the hypotheses hitherto proposed, M. Julia Fontenelle concludes that this phenomenon is the result of an internal decomposition, and is altogether independent of the influence of external agents. We give his own words:

"We consider," says he, "what are called spontaneous combustions of the human body, not as true combustions, but as intimate and spontaneous reactions, which depend upon new products originating from a degeneration of the muscles, tendons, viscera," &c. "These products, on uniting, present the same phenomena as combustion, without losing any of the influence of external agents, whether by admitting the effect of the opposite electricities of Berzelius, or by adducing in example, the inflammation of hydrogen, by its contact with chlorine, arsenic, or pulverized antimony, projected into this latter gas," &c.

It may be objected, however, that, whatever may be the cause which induces this combustion, the caloric disengaged ought to be considerable, and, consequently, should ignite all the objects in the neighbourhood. We reply to this, that all combustible substances do not by any means disengage an equal quantity of caloric by combustion. Davy has shown, that a metallic gauze, having 160 holes in the square inch, and made of wire one-sixtieth of an inch in diameter, is penetrated at the ordinary temperature, by the flame of hydrogen gas, while it is impermeable to that of alcohol, unless the gauze be very much heated. According to the same chemist, gauze of this kind, raised to a red heat, allows the flame of hydrogen gas to pass through it, without being permeable to percarburetted hydrogen gas. It is probable from this, that the products arising from the degeneration of the body, may be very combustible, without, however, disengaging as much caloric as the other combustible bodies known, and without leaving a residuum, as the two latter gases; and, in fine, we are of opinion, that, in some subjects, and chiefly in women, there exists a particular diathesis, which, conjoined with the asthenia occasioned by age, a life of little activity, and the abuse of spirituous liquors, may give rise to a spontaneous combustion. But we are far from considering as the material cause of this combustion, either alcohol, or hydrogen, or a superabundance of fat. If alcohol plays a prominent part in this combustion, it is by contributing to its production; that is to say, it produces, along with the other causes mentioned, the degeneration of which we have spoken, which gives rise to new products of a highly combustible nature, the reaction of which determines the combustion of the body.

It is to be regretted, that the observations hitherto published, are not more complete. We propose to ourselves to collect all that may tend to throw light upon a subject so important in anthropology and medical jurisprudence.

*Innocuous Nature of Putrid Exhalations.*

A COMMITTEE have been engaged in France, in examining the circumstances relative to the knacker's operations. His business consists in killing old worn-out horses, and turning every part of their body to account. The most singular results which the committee have obtained, relate to the innocuous nature of the exhalations, arising from the putrefying matter; every body examined, agreed that they were offensive and disgusting, but no one that they were unwholesome; on the contrary, they appeared to conduce to health. All the men, women, and children, concerned in the works of this kind, had unvarying health, and were remarkably well in appearance, and strong in body. The workmen commonly attained an old age, and were, generally, free from the usual infirmities which accompany it. Sixty, seventy, and even eighty, were common ages. Persons who live close to the places, or go there daily, share these advantages with the workmen. During the time that an epidemic fever was in full force at two neighbouring places, not one of the workmen in the establishment at Montfaucon was affected by it. It did not appear that it was only the men who were habituated to the works that were thus favoured; for when, from press of business, new workmen were taken on, they did not suffer in health, from the exhalations.

In confirmation of the above observations, similar cases are quoted: above 200 exhumations are made yearly at Paris, about three or four months after death; not a single case of injury to the workmen has been observed. M. Labarraque has observed, that the catgut makers, who live in a continually putrid atmosphere, arising from macerating intestines, enjoy remarkable health. Similar circumstances were remarked, at the exhumations of the Cimetière des Innocens.

Whatever disease the horse may have died of, or been killed for, the workmen have no fear, adopt no precautions, and run no risk. Sometimes, when strangers are present, they pretend to be careful, but, upon close inquiry, laugh at such notions. They handle diseased as well as healthy parts, *always with impunity*. They frequently cut themselves, but the wounds heal with the greatest facility, and their best remedy is, to put a slice of the flesh about the wound.

On making inquiry of those to whom the horse-skins were sent, and who, besides having to handle them when very putrescent, were more exposed to effects from diseases in the skin, they learnt that these men, also, from experience, had no fear, and never suffered injury. Horse-skins never occasioned injury to those who worked them, but in this they differed from the skins of oxen, cows, and especially sheep, which sometimes did occasion injury, though not so often as usually supposed. [*Recueil Industriel*, v. 55.

*Account of the Restoration of Hair, by the use of Sulphate of Copper, (blue vitriol.)*

A MAN between twenty and thirty years of age, of strong and healthy constitution, having a short, curly, and coarse hair, of a dark brown colour, found himself becoming bald. Numerous and large bald spots appeared on the head, and gradually increased until it became perfectly bare, and as the eye-lashes fell out, the man had quite a singular and disagreeable appearance. When the head was closely examined, a short, white, and scattered down, very similar to a slight degree of mouldiness, was perceptible. At first it was hoped, that the hair would grow again, but the sequel proved the contrary; after two years, Dr. Radimacher advised him to pour French brandy upon sulphate of copper, (blue vitriol,) and, when it had remained a few days, to wash the bald parts once a day with the solution. In eight days, the hair had begun to grow, and in four months it equalled the original growth in quantity, but was of a lighter colour, crisp, dry, and stiff, and had not a natural appearance. A spot still remained bald on the back of the head. The eye-brows and lashes grew again like the rest of the hair. A year after this, the man shed his hair again, but the eye-brows and lashes remained. Dr. R. wished him now to wait awhile, to ascertain whether the hair would or would not grow again spontaneously, but the patient would not, and had recourse to the solution, which produced another growth of bland or light hair, and the spot, which before had continued bald, notwithstanding the solution, became covered in common with the other parts of the head. This growth had a much more natural appearance than the former one. [*Med. Journ.* lix. 470.

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*On the Natural History of the Honey Bee, and the importance of its products.*

[Extracted from the North American Review, for October last.]

THE bee seems to be a native of every part of the globe, and the same characteristic traits distinguish the whole race; we allude simply to the honey bee, *Apis Mellifica*. Even in New South Wales, we find that, excepting in some variation of size and colour, the honey bee is the same with that of Europe and America. The history of one bee, and of one community of bees, is, with the slight variation which is always produced by climate, the history of the whole race; nor should we venture to add our stock of observation to the great mass of what is already known upon the subject, and accessible to every class of persons, did we not wish to excite the attention more particularly of those who inhabit the mountainous districts of this portion of our country, to this practicable and profitable branch of horticulture.

From the commencement of history, to our own day, bees have been an object of attention, honey has been used, and wax has been an article of commerce. In fact, the amount of the former consumed for food, medicine, and a pleasant beverage, and of the latter for various purposes in the arts, would astonish those who have never turned their attention to the subject. In the savage and civilized state, wherever there has been sun enough to mature a flower, every individual of the community is as familiar with the luxury of honey, and the merits and uses of bees'-wax, as with the daily food that is consumed.

Man has never been slow to appropriate to himself the physical powers of the inferior animals; but of all those which have been subdued toshis use, the bee alone has preserved its independence. We ought not, in fact, to use the term *subdued*, as it does not apply to the situation or position which the bee holds among us in its domestic state. Neither its nature nor its habits are, in any wise, altered or modified. It preserves its singular economy unchanged, whether it inhabit a hollow tree in the midst of an unfrequented forest, or a hive in the centre of an apiary.

And here, we would remark, that a hive ought not to be considered as the house or habitation of the bee, for even in the forests, where there may be supposed to be abundance of hollow trees suited to their purposes, bees have built their cells on the under side of a stout branch; and they have neglected the convenient form of a well constructed hive, to attach themselves to the eaves of a house, or to the inner sides of a chimney. The nature of this part of their instinct, goes no further than to secure a *firm* roof, to which they can attach the cells, and a position that shall protect the cells from the sun and rain.

This faculty, or instinct, is sometimes at fault, for we often hear of their adopting the strangest and most unsuitable tenements for the construction of cells. A hussar's cap, so suspended from a moderate sized branch of a tree, as to be agitated by slight winds, was found filled with bees and comb. An old coat, that had been thrown over the decayed trunk of a tree and forgotten, was filled with comb and bees. Any thing, in short, either near the habitations of man, or in the forests, will serve the bees for a shelter to their combs.

If this instinct were as absolute as some persons would make us believe, the bees, when swarming, would, undoubtedly, choose a domicile, as nearly similar to the one they had left, as possible; but this is rarely the case. In their pursuit of food, with which the woods as frequently supply them as the gardens, their quick eye guides them to the places suitable for the establishment of a swarm. They do not, by a distinct succession of thoughts, arrive at the conclusion, that the hollow tree will suit them as a dwelling; but they find it unoccupied, they pass it daily, and when the whole swarm is collected on the branch of a tree, these foraging scouts, that have espied the hollow tree, run over the mass of bees as they hang, give

the signal of departure, lead the way to the woods, and the queen and the whole swarm follow to the selected tree.

But, although the bees are rarely unprovided with a retreat for a new swarm, yet they readily accept of a more obvious one, when offered. Aware of this willingness on the part of the bees, man takes the opportunity, when they are collecting their numbers, of introducing them into a hive, and of bringing them under his own immediate *surveillance*, that he may the more easily partake of the fruits of their labours. Yet, although colony after colony have dwelt in uninterrupted succession in a particular apiary, their instinct is not improved, nor their reflective powers enlarged. They are the same in all their instincts and formations, as they were, when the first observations on their habits, with which we are acquainted, were made.

We have, for seven years, had a little colony under our immediate inspection, and we began our personal observation with the knowledge of all that ancient and modern theorists have advanced, in relation to the habits, customs, and manners, of this wonderful insect. We came to their superintendence with a mind tinctured with all that was marvellous and fanciful, and with an ardour that seven years have not subdued; although theory after theory has now melted away, and most of the wonders and enigmas have been solved, and reduced to the clearest and most simple particulars. Our wonder and admiration, although deprived of the charms of the fanciful legends in which the history of the bee was embodied, are still undiminished, nay, increased; for an elevation of thought and feeling has been produced by the study.

Notwithstanding the astonishing sagacity to be traced in the economy of bees, and the diversity of habits which might be expected, nature, in reality, is less variable in this instance, than in most others; for although climate and a contracted habitation may reduce their size, and scantiness of food reduce their numbers, yet, as long as there are flowers, the bee will abstract the honey, and as long as there are forests, the bee will construct a cell. With other insects and animals, and even with man himself, the case is different. Insects will imbibe nourishment from the exudations of both animal and vegetable substances. Man can accommodate himself to every variety of diet, and thrive on all. The bee alone never changes its food. The sweet sap that exudes from vegetable pores, and which is accumulated in the nectary of flowers, serves alike to sustain the bee, and to render the seeds of plants fit for germination. As no flower can arrive at maturity without the assistance of this fluid, it is ever present; and as the bee has a two-fold duty to perform, that of preserving its own being by such means as nature has pointed out, and that of assisting the winds in carrying the pollen from flower to flower, creative wisdom has so arranged it, that the peculiar food of the bee is in abundance. And as this nutritive fluid is to support inanimate life, which requires an unvaried and uniform food, the bee for ever partakes of the same nourishment, and is

enabled to preserve its peculiarities of form and instinct unaltered, from generation to generation.

For both the operations, therefore, of sustaining life and of dispersing pollen, which require uniformity of instinct and organization, the bee is the same in all situations and in all ages. The working bees have the instinctive faculties of building different shaped cells; of choosing and preparing the food, both for the larvæ and for themselves; of taking care of the young brood; of carrying off noxious and extraneous matter; of defending themselves from enemies of *their own species;* and of expelling the drones when they are no longer of use in the hive. They have the instinctive knowledge that they cannot, as other insects do, exist individually; they are constructed, therefore, in so admirable a manner, as to make every thing subservient to the safety and comfort of the mother of the brood. She is, in their estimation, as much a part of themselves, as an eye or a limb. Their care of her is a kind of self-preservation, a law implanted in every living thing.

After rejecting all the fanciful and marvellous speculations of the theorists, there are still several material points unsettled, on three of which we propose to make a few remarks at the present time.

1st. The most modern and the most rational theorists differ in their opinions respecting the accuracy of the facts, that are stated in relation to the queen bee's leaving the hive at any other time, than when she goes forth with a new swarm.

2d. They dispute, likewise, on the possibility of the bees making a queen bee, from a neuter, when circumstances require it.

3d. They are still ignorant, whether the drones perform the office of nurse to the larvæ when deposited in the different cells.

On the first point, we venture to state unhesitatingly, that *the queen bee never leaves the hive, but when she accompanies a swarm.* For ten weeks, we fixed our attention on the entrance of two hives that stood close to each other on a bench. Our watch, either in person, or entrusted to another as interested and vigilant as ourselves, commenced at gray dawn, and continued till sunset; and never within that period did the queen bee of either hive leave them, but at the time of swarming, which occurred once in each hive during our inspection. With an eye to this single circumstance, we have, for six successive years subsequent to the careful observation just stated, been in the constant habit of noting every peculiar movement at the entrance of hives, but we never saw the queen. Independently of the reliance that can be placed on observations of this kind, we have confirmation derived from strong probabilities.

The average number of a hive or swarm, is from fifteen to twenty thousand bees. Nineteen thousand four hundred and ninety-nine are neuters, or working bees, five hundred are drones, and the remaining *one* is the queen or mother! Every living thing, from man down to an ephemeral insect, pursues the bee to its destruction, for the sake of the honey that is deposited in its cell, or secreted in its honey-bag. To obtain that which the bee is carrying to its hive, numerous birds and insects are on the watch, and an incredible

number of bees fall victims, in consequence, to their enemies. Independently of this, there are the changes in the weather, such as high winds, sudden showers, hot sunshine; and then there is the liability to fall into rivers, besides a hundred other dangers to which bees are exposed.

Can any one, who considers all these casualties, suppose, that the instinct in bees is so defective, as to allow so important a member of the community, and the only one of the kind, too, to leave the hive and run the immense risk that would attend an excursion in the air? It is a well established fact, that one queen lays all the eggs of the hive; that part of the daily duties of the working bees, is to nourish the young brood, which, if there were no queen, they could not do, as there would be no eggs. If the bees are disturbed in their regular routine of business, they become uneasy and incapable of proceeding. When they return from the nectary of flowers, with the usual quantity of sweet fluid, they hasten to bestow the first or uppermost part of honey on the larvæ and young bees; and when this simple, undigested liquid is disposed of, they deposit that which has gone through a certain chemical process, in the cells.

If, therefore, on entering the hive, they find no queen, they run about anxious and distressed, drop the little pellets of pollen that are attached to their legs, strike their antennæ against one another, and are in great agitation during the day. Sometimes two days are passed in this restless state, before they make an effort to repair their loss.

If the queen bee were to leave the hive, as Huber and others fancy, she would run great risk of never being able to return to it. Even around the apiary, before she had made the usual evolutions in the air, common to all bees on leaving the hive, she might become the prey of one of the many birds, that are hovering over head, or on the watch. The blue-bird, the king-bird, and the cat-bird, swallow bees by dozens, while on the wing; and the queen bee would have less chance of escape, as she is larger, and, therefore, more conspicuous, and is, besides, very slow and heavy in her motions, her wings being smaller, in proportion to her body, than those of the working bee and the drone.

From our own observations, therefore, as well as from the above inferences, we must believe that the queen bee *never* leaves the hive, but for the establishment of a new colony.

The next material point of dispute is, whether it be in the power of the working bees to convert the larva of a working bee into that of a queen, when by accident the hive is deprived of one. According to the most accurate naturalists, the organization of the queen, or mother bee, is different from that of either the drone or the neuters. It appears to us quite as rational and philosophical to suppose, that a queen bee could be converted into a neuter, and, therefore, that all bees, at first, were of the shape and organic structure of the queen, as to suppose that a neuter, or working bee, could have new organs added, new curves given to its limbs, and new instincts to its nature.

If we could see the interior of a hive, whenever it suited our convenience, we should not be so lost in conjecture; but the irritability of these little insects, prevents a constant and minute internal inspection. It is a part of their instinct to know, that *light*, *heat*, *cold*, and *moisture*, in an undue and unaccustomed degree, are prejudicial to the formation of wax, to the consistence of the honey, and to the health of the brood. They, therefore, use all the little arts and advantages they possess, to prevent any one from exposing them to the injurious influence of these active powers.

When a queen bee ceases to animate the hive, the bees are conscious of her loss; after searching for her through the hive, for a day or more, they examine the royal cells, which are of a peculiar construction, and reversed in position, hanging vertically, with the mouth underneath. If no eggs or larvæ are to be found in these cells, they then *enlarge* several of those cells, which are appropriated to the eggs of neuters, and in which *queen eggs have been deposited.* They soon attach a royal cell to the enlarged surface, and the queen bee, enabled now to grow, protrudes itself by degrees into the royal cell, and comes out perfectly formed, to the great pleasure of the bees.

Now this, in itself, is curious and wonderful. There is no need of adding superhuman powers to an insect, when the simple facts show such singular sagacity. The truth is, that the queen, or mother bee, lays the neuter eggs in certain cells of a particular construction; in fact, the eggs are laid, at least many of them, as soon as the foundations are begun, before the cells are built. The bees know, from the peculiar shape of the egg, that it is to have a cell of certain dimensions. When the neuter and drone eggs are deposited, the royal cells are then filled, for abundant observations prove that the queen eggs are laid last. If the royal cells are not sufficient to hold all the queen eggs, they are laid in the *common cells*, and in the course of the regular business of the hive, these cells are attended to with the rest. When the larva is of a size to fill the cell, a covering of wax is put on, and here ends the life, or rather the embryo of the queen; for no longer having room to expand, it perishes, and is dragged out in the nymph form, as soon as the bees discover that animation is extinct. If, during the progress of the egg from the larva to the nymph state, the mother queen dies, and there are no eggs in the royal cells, then the bees have recourse to the queen eggs that are laid in the common cells. By enlarging the entrance, and by attaching to it a cell, which hangs *vertically*, they continue the life of the larva, and a queen bee is formed.

Here is no work of transformation. The insect is already formed, and nothing remains to be done, but the mere mechanical operation of building a habitation, which shall be adequate to its wants. The peculiar organic construction of the queen bee, perhaps, requires a difference of food, as we perceive it does of dwelling. No doubt it is necessary to supply it more abundantly, and with greater care.

The very position it is compelled to take, shows that it requires a different kind of nurture from either the common bee or the drone.

It is wonderful that instinct is so competent to direct these changes; but it would be more than wonderful, if, in addition to this instinct, the bee had the power *to construct new organs*, as it does different cells, and thus to endow the insect with a different nature.

The third point unsettled, and which is likely to remain for ever a secret, is, whether the eggs of the queen are hatched after the manner of the eggs of fishes, whether they simply are animated by incubation, or by the care and nourishment bestowed upon them by the working or neuter bees.

On this point, experiment has proved nothing. The greatest diversity of opinion exists. There are upwards of a thousand writers on the history and policy of the bee, and yet no two have either observed or reasoned alike. Even the two distinguished naturalists, who have passed the best portion of their lives in studying bees, with equal zeal and with equal opportunity, have come to very different conclusions. Huber is by far the most circumstantial experimentalist, who has turned his attention to this subject. But his truly philosophical mind, has been rendered comparatively useless, nay, worse than useless, by the ignorance or wilful misrepresentations of his assistant, Francis Burnens. Huber could but philosophize on facts as they daily were represented to him. His solutions of things *unreal*, and having *no truth in nature*, are most ingenious and rational. Had his physical sight been as perfect as his mental vision, his work would, doubtless, have been all that could be effected by the industry and talent of man.

The naturalists of Europe, misled by his extraordinary talent, adopted Huber's notions with respect to bees, and his opinions were considered as conclusive. The public opinion became imbued with the spirit of his doctrines; and we find the greatest and acutest reasoners discussing, in perfect security, the nature of an insect, that could at one moment organize animal life, and impart to it new instincts, and in the next, construct bulwarks and other modes of defence, to protect himself from an enemy, that until the last century, never molested him.

The real fondness that was inspired for the study of the bee, by the interesting work of Huber, engaged many in the pursuit; and the very mistakes that he has made, have led to something nearer the truth. Owing to the general improvement in education, the taste for the marvellous is fast disappearing; and there are now many who set themselves down to the study with their reason unbiassed, and their judgment free to decide according to the evidence of facts.

Huish, amongst the late writers, has most successfully combatted the principal errors in Huber's theory; but, although he has fixed a base on which a rational theory may be built, his object seems less to elicit truth, than to expose the errors of Huber. This he has endeavoured to do in the most unamiable and bitter spirit, which destroys the gratification with which his book would be read by the candid inquirer. In addition to this, he has laid himself open to the charge of plagiarism. He must have studied the subject sufficiently to acquire a knowledge of the different forms of hives, that

have been in use from the earliest antiquity to his own time; and the peculiar shape of the Greek hive could not have escaped his vigilance, for drawings and descriptions of it are within the reach of every student; yet he boldly states, that a flower-pot first gave him the hint of the plan which he adopted for his own hive.

[TO BE CONTINUED.]

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## *On the Cohesive Strength of Beams, Bars, &c.*

[From Brunton's Compendium of Mechanics.]

AFTER considering the mechanical powers which are the constituent principles of all machines, the next step is to consider the strength of the materials of which machinery is composed—this knowledge being of the greatest importance to the mechanic, by enabling him to adjust, with respect to magnitude, the various parts of the machine, that the strength of each part may be proportional to the stress it has to sustain.

The cohesive strength of a body, is that force by which its fibres or particles resist separation; therefore, the more particles that are in a body, the greater will be the power requisite to tear them asunder, according to the rule, that the strength of bodies is as the area of their cross sections.

Our knowledge in this property of bodies, is very limited, there being very few experiments made on which to build a theory, and these few do not agree.

The following are the results of experiments made by Mr. Emerson, which state the load that may be safely borne by a square inch rod of each substance.

| | Pounds Avoirdupois. |
|---|---|
| Iron rod, an inch square, will bear | 76,400 |
| Brass, | 35,600 |
| Hempen rope, | 19,600 |
| Ivory, | 15,700 |
| Oak, Box, Yew, Plum-tree, | 7,850 |
| Elm, Ash, Beech, | 6,070 |
| Walnut, Plum, | 5,360 |
| Red Fir, Holly, Elder, Plane, Crab, | 5,000 |
| Cherry, Hazel, | 4,760 |
| Alder, Asp, Birch, Willow, | 4,290 |
| Lead, | 430 |

Mr. Barlow's opinion of this table is, "we shall only observe here, that they all fall very short of the ultimate strength of the woods to which they refer." *See Barlow's Essay on the strength of Timber, Art.* 3.

Mr. Emerson, also, gives the following practical rule, viz. "that

a cylinder, whose diameter is $d$ inches, loaded to one-fourth of its absolute strength, will carry as follows:—

| | *Cwt.* |
|---|---|
| Iron, | $135 \times d^2$ |
| Good Rope, | $22 \times d^2$ |
| Oak, | $14 \times d^2$ |
| Fir, | $9 \times d^2$ |

Captain S. Brown made an experiment on Welsh pig iron, and the result is described as follows:

"A bar of cast-iron, Welsh pig, 1¼ inch square, 3 feet 6 inches long, required a strain of 11 tons, 7 cwt. (25,424 lbs.) to tear it asunder, broke exactly transverse, without being reduced in any part; quite cold when broken; particles fine, dark bluish gray colour." From this experiment, it appears that 16,265 lbs. will tear asunder a square inch of cast-iron.

Mr. G. Rennie, also, made some experiments on cast-iron, and the result was, "that a bar one inch square, cast horizontal, will support a weight of 18,656 lbs.—and one cast vertical, will support a weight of 19,488 lbs."

There have been several experiments made on malleable iron, of various qualities, by different engineers.

The mean of Mr. Telford's experiments, is 29¼ tons.
The mean of captain S. Brown's do. is 25 do.

and the mean between these two means, is 27 tons, nearly; which may be assumed as the medium strength of a malleable iron bar 1 inch square. *See Barlow's Essay, page* 235.

From a mean, derived by experiments, performed by Mr. Barlow, it appears that the strength of direct cohesion, on a square inch of

| | | *lbs.* |
|---|---|---|
| Box | is about | 20,000 |
| Ash | — | 17,000 |
| Teak | — | 15,000 |
| Fir | — | 12,000 |
| Beech | — | 11,500 |
| Oak | — | 10,000 |
| Pear | — | 9,800 |
| Mahogany | — | 8,000 |

These weights may be taken as correct data for the cohesive strength of the wood to which they belong; but this is the absolute and ultimate strength of the fibres; and, therefore, if the quantity that may be safely borne be required, not more than two-thirds of the above values must be used.

### *Transverse strength of Beams, Bars, &c.*

If a beam be supported at both ends, and loaded in the middle, it will bend, (which is called deflection;) and if the load be increased, it will break, (which is called fracture.)—If a beam 2 inches deep and one inch broad, support a given weight, another beam of the same depth, and double the breadth, will support double the weight:—hence, beams of the same depth are to each other as their

breadths:—again, if a beam 2 inches deep, and 1 inch broad, support a given weight, another beam of 4 inches deep, and 1 inch broad, will support four times the weight;—hence, beams of equal breadths are to each other as the squares of their depths:—again, if a beam of a given cross section 1 foot long, support a known weight, another beam of the same cross section, but 2 feet long, will support only half the known weight:—hence, beams of equal dimensions are to each other inversely as their lengths; therefore, the strength of beams is directly as their breadths and square of their depths, and inversely as their lengths; and if cylindrical, as the cubes of their diameters.

*Practical Problems for the Transverse Strength of Timber.**

TABLE OF MULTIPLICANDS.

| | |
|---|---|
| English Oak | 1426 |
| Canadian do. | 1766 |
| Ash | 2026 |
| Beech | 1556 |
| Elm | 1013 |
| Pitch Pine | 1632 |
| Red Pine | 1341 |
| Fir | 1100 |
| Larch | 1127 |

PROBLEM I.

*To find the ultimate transverse strength of any Rectangular Beam of Timber, fixed at one end, and loaded at the other.*

*Rule.* Multiply the number in the table of multiplicands, by the breadth and square of the depth, both in inches, and divide that product by the length, also, in inches; the quotient will be the weight in lbs.†

*Example* 1.

What weight will it require to break a beam of fir, the breadth being 2 inches, depth 6 inches, and length 20 feet?

$$\frac{1100 \times 36 \times 2}{240} = 330 \text{ lbs.}$$

*Example* 2.

What is the weight requisite to break a beam of ash, 7 inches square, 3 feet from the wall?

$$\frac{2026 \times 7^{3}}{36} = 19303\tfrac{1}{36} \text{ lbs.}$$

* See Barlow's Essay on the strength and stress of timber, *Art.* 149.

† When the beam is loaded uniformly throughout its length, the same rule will still apply, only the result must be doubled.

PROBLEM II.

*To compute the ultimate transverse strength of any Rectangular Beam, when supported at both ends and loaded in the centre.*

*Rule.* Multiply the number in the table of multiplicands, by the square of the depth in inches, and four times the breadth; divide that product by the length in inches, and the quotient will be the weight.

*Example* 1.

What weight will break a beam of English oak 7 inches broad, 9 inches deep, and 30 feet between the props?

$$\frac{1426 \times 81 \times 28}{360} = 8983\tfrac{288}{360} \text{ lbs.}$$

*Example* 2.

A beam of beech, 7 inches deep, 4 inches broad, and 10 feet long, supports a weight of 4 tons, what additional weight will require to be added to break the beam?

$$\frac{1556 \times 49 \times 16}{120} = 10352 - 8960 = 1372 \text{ lbs.}$$

When the beam is uniformly loaded throughout its length, the result must be doubled, *i. e.* it will support double the weight.

When the beam is fixed at both ends and loaded in the middle, one-half of the result must be added; and if the weight is laid uniformly along its length, the result must be tripled.

These problems are taken from Barlow's Essay, as before quoted: he, however, gives a second rule to each of the problems, in which the angle of deflection is considered. These rules give higher results than those here stated; but for practice, the first rule is the best, being more simple and safe.

It is considered that two-thirds of the result is sufficient to lay upon a beam for a permanent load.

*Practical Problems for the Transverse strength of Cast-Iron Beams.**

PROBLEM I.

*To find the breadth of a uniform Cast-Iron Beam to bear a given weight in the middle.*

*Rule* 1. Multiply the length of bearing in feet, or the length between the supports, by the weight to be supported in lbs.; and divide this product by 850 times the square of the depth in inches; the quotient will be the breadth in inches required.

*Rule* 2. Multiply the length of bearing in feet, by the weight to be supported in lbs., and divide this product by 850 times the breadth in inches; and the square root of the quotient will be the depth in inches.

* See Tredgold's Practical Essay on the Strength of Cast-iron, p. 80.

When no particular breadth or depth is determined by the nature of the situation for which the beam is intended, it will be found sometimes convenient to assign some proportion; as, for example, let the breadth be the $n^{th}$ part of the depth, $n$ representing any number at will. Then the rule is as follows:—

Multiply $n$ times the length in feet, by the weight in lbs.; divide this product by 850, and the cube root of the quotient will be the depth required; and the breadth will be the $n^{th}$ part of the depth.

*Note.* It may be remarked here, that the rules are the same for inclined as for horizontal beams, when the horizontal distance between the supports is taken for the length of bearing.

*Example* 1.

What is the breadth of a beam 20 feet long, 15 inches deep, and to be loaded with 13 tons?

13 tons = 29120 lbs.

$\frac{29120 \times 20}{15^2 \times 850} = 3.045$ inches broad.

*Example* 2.

What is the depth of a beam 20 feet long, 3 inches broad, and to support a weight of 13 tons?

$\frac{29120 \times 20}{850 \times 3} = 225$, the square root of which is = 15 inches, the depth required.

*Example* 3.

What are the cross sectional dimensions of a beam 30 feet long, and of sufficient strength to support a weight of 10 tons; the depth being twice the breadth?——$n$ will therefore be = 2

10 tons = 22400 lbs. Length = 30 $30 \times \overset{n}{2} = 60$

$\frac{22400 \times 60}{850} = 1581$, the cube root of which is nearly $11\frac{1}{2}$, which is equal to the depth in inches: the breadth is the half of the depth $= 5\frac{3}{4}$ inches.

PROBLEM II.

*To find the breadth, when the load is not in the middle between the supports.*

*Rule.* Multiply the short length by the long length, and four times this product divided by the whole length between the supports, will give the effective leverage of the load in feet; this quotient being used instead of the length, in any of the rules in the foregoing problem, the breadth and depth will be found by them.

*Example.*

What are the cross sectional dimensions of a beam 12 feet long,

supporting a weight of 15 tons, 3 feet from the one end, when the breadth is a fourth of the depth?

$\frac{3 \times 9 \times 4}{12} = 9 \quad 9 \times 4 = 36 \quad 15 \text{ tons} = 33600 \text{ lbs.}$

$\frac{33600 \times 36}{850} = 1423$, the cube root of which is $= 11\frac{1}{4}$, the depth: the breadth will be $\frac{11\frac{1}{4}}{4} = 2\frac{13}{16}$

### Problem iii.

*To find the breadth when the load is uniformly distributed over the length of the beam.*

*Rule.* The same rules apply as in prob. 1, only the divisor is changed from 850 to 1700, *i. e.* when the load is uniformly distributed over the length of the beam, it supports double the weight than when the load is laid on the middle.

*Note.* Examples in problem 1, apply to this problem, only changing the divisors, or halving the quotients.

### Problem iv.

*To find the dimensions, when a beam is fixed at one end and loaded at the other, or when it is supported at the middle and loaded at both ends.*

*Rule.* Take the horizontal length of the projection of the beam, when fixed at one end, for the length, and apply the rules in prob. 1, only using the divisor 212 instead of 850.

When the beam is supported any where between the two ends, multiply the length from the prop by the weight hung at the end, and apply the remainder of the rule as in prob. 1, only using 212 for 850.

When the load is uniformly distributed over the length of the projection, employ 425 instead of 212 as a divisor.

*Note.* The rules of this problem apply to the teeth of wheels, the length being the length of the teeth, and the depth, the thickness of the teeth.

*Example to this Note.*

Let the greatest power acting at the pitch line of the wheel be 6000 lbs., and the thickness of the teeth $1\frac{1}{4}$ inch, the length of the teeth being $\frac{1}{4}$ foot; what is the breadth of the teeth?

$\frac{6000 \times .25}{212 \times 1.5^2} = \frac{1500}{477} = 3.14$ inches the breadth; but to allow for wearing by friction, this quotient is doubled, or $6\frac{1}{2}$ inches = the breadth of the teeth, or face of the wheel.

PROBLEM V.

*To find the diameter of a solid cylinder to support a given weight in the middle—between the middle and the end—and when the weight is uniformly distributed over the length—also when fixed at one end.*

*When the weight is placed in the middle.*

*Rule.* Multiply the weight in lbs. by the length in feet; divide this product by 500, and the cube root of the quotient will be the diameter in inches.

*When the weight is between the middle and the end.*

*Rule.* Multiply the short end by the long end; then multiply that product by 4 times the weight in lbs. Divide this product by 500 times the length in feet, and the cube root of the quotient will be the diameter in inches.

*When the load is uniformly distributed over the length.*

*Rule.* Multiply the length in feet by the weight in lbs., and one-tenth of the cube root of the product will be the diameter in inches.

*When fixed at one end, and the load applied at the other.*

*Rule.* Multiply the length of projection in feet by the weight in lbs., and the 5th part of the cube root of this product will be the diameter in inches.

The rules for the deflection of beams and bars are here omitted, it being considered, that, in most practical cases, the deflection is of little importance; however, when it is of importance, reference to Barlow's Essay on the strength of timber, and Tredgold's Essay on the strength of iron, will satisfy all inquiries. These books ought to be in the possession of every mechanic, as they give the most comprehensive and most correct data, for the strength of materials, of any that have yet appeared.

[TO BE CONTINUED.]

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## *Remarks upon Bleaching.*

THE improvements made in the art of bleaching during the last half century, have, in some measure, conquered the prejudices inseparable from long established habits; and practical men, though strongly wedded to their own methods of working and sufficiently jealous of projected improvements, have yielded reluctantly to a conviction of their utility. It is presumed, that the usual method of chemical bleaching as now practised, both in Europe and the United States of America, is too well known to require a particular description. In that method, there appears to me to be a fundamental error in the alternate use of hot and cold liquors. It is evident, that a heated solution of alkali opens and expands the fibres

of linen submitted to its action, and thus affords an opportunity for the alkali to act upon its colouring matter, and to increase its solubility. But the second step in the ordinary process of bleaching, counteracts the first. The linen is taken *hot* from the bucking tub, and immediately thrown into *cold water*, for the purpose of being washed. The fibres of linen collapse; the colouring matter is condensed, and its affinity for the linen is restored, which is manifestly the reverse of the object intended to be gained by the process.—If the rinsing water be of the same temperature as the alkaline liquor, this reaction is prevented.

2dly. From this washing in cold water, the linen, after having been bucked a sufficient number of times, and exposed for months to the air in the fields, comes, in due course of time, to its second stage of operation.

The linen in large quantities, is immersed in vats of cold chloride of lime, in a quiescent state, and the bleaching properties of the liquor act upon it imperfectly and unequally, in consequence of the dense mass of linen, and the frigidity of the medium through which it has to act.

If the linen were put into the bleaching liquor moderately warmed, confined so as to prevent the escape of gaseous vapours, and then set into regular and constant motion, these objections would be obviated; the effect of the warm liquor would be uniform and active, which can never be the fact while it is cold, and in a state of rest.

What I have remarked concerning the manner of using alkaline and chloruretted liquors, applies with equal truth to the use of acidulated water in the third stage of bleaching.

3dly. The third most important point to be considered in the process of bleaching, is, the degree of heat to which the linen is subjected.

Bleachers are generally sensible of the advantages of heat, and various contrivances have been adopted to apply *steam heat* to the purposes of bleaching. But I am not aware that any one has attempted to bring his goods into *action* in steam heat *under pressure*. Nor do I know that there has ever been any mechanical invention brought into practice, by which it could be done, until my machine was constructed. The French bleachers have taken much pains to use an alkaline solution at a temperature above boiling heat, but without success. They seem to have a correct idea of the probable effect of increments of heat above that degree, but failed in their attempts to reach it, through the imperfection of their mechanical inventions.* But I can find no evidence of their ever having conceived an idea of the advantages likely to result from the combined action of *heat* and motion.

Unless the steam is brought to act *under pressure*, it is evident that no material benefit is gained by steaming instead of boiling—often the reverse, because the heat will never exceed, and the moment it is exposed to the atmospheric air, will fall below 212° Fah-

* Vide Berthollet on Dying.

renheit, or boiling heat. But if the steam is *confined*, it is easy to raise its heat to 230°, and then the effect upon the linen, shows, in the most unequivocal manner, the advantages of augmented heat in bleaching. This effect is not only more strikingly obvious, but is singularly beautiful, when the goods are put in motion, and the degree of bleaching is rendered perfectly uniform.

There can be no danger, as some have apprehended, of injuring the linen by excessive steam heat, because the scorching heat of steam is 520° Fah.—a pressure of fifty atmospheres, or seven hundred and thirty-five pounds upon a square inch—a pressure which no ordinary steam apparatus will resist.

Steam heat at 350° thermometical measurement, will so far soften soldering, as to cause it to yield to the pressure, and the steam pipes will burst. These are facts which I state as the result of my own repeated experiments, in which I cannot be materially mistaken, and, therefore, I feel justified in saying, that it is not possible, with any ordinary working apparatus, to carry steam to so high a temperature as to injure any goods submitted to its action. By giving motion to the linen, under the reciprocal action of steam heat, under pressure, and alkaline liquor, the effect is not only more powerful than it can be by bucking, but, as already hinted, it is more uniform. Every part of the cloth is equally exposed to the operation, and the colouring matter detached from the cloth, floats in the liquor below.

This appears to me to determine the question which some have raised, whether the colouring matter of linen is actually detached from the cloth, or is bleached upon it without being detached? When we find that the loss of weight, in the various methods of bleaching, ranges from twenty to thirty per cent.—and when we find the colouring matter suspended in the liquor, and reducible by evaporation to a mucus, it seems to me that there can be no doubt that the colouring matter is removed—at any rate, a large proportion of it. The repeated experiments which I have made upon a considerable scale in bleaching, clearly demonstrate the utility of combining heat and motion. The action is direct, immediate, and uniform. The strong affinity which unites the colouring, the glutinous and the oleaginous matter to the fibres of the linen, is weakened and rapidly overcome, and no opportunity is afforded for their subsequent combination.

By this method I have bleached Scotch drills in twelve hours, and Manchester cotton shirtings in four. There will be no occasion to croft cotton goods, but linens receive a clearer and more brilliant white, by exposure upon the grass for a few days.

JUNIUS SMITH.

*Liverpool, Jan. 15th,* 1828.

P. S. I have omitted to notice, that the saving in alkali by this method of bleaching, compared with the usual consumption by the English, Scotch, and Irish bleachers, is about twenty-five per cent.

[*Silliman's Journ.*

## *On the Action of the Moon on the Atmosphere.*

The Bib. Univ. for Dec. 1827, contains a valuable memoir on this subject, by M. Flaugergues, astronomer at Viviers, in France. The author observes, that many geometricians have been engaged in researches on the action of the moon upon the barometer, but that their labours have not been attended with very satisfactory results. Nor have the labours of meteorologists been much more successful. The observations of some of these are contradictory and irreconcilable with each other. Several have inferred that the barometer is higher during the time the moon is in perigee than when she is in apogee; and others, that the mean height is greater in the syzygies than in the quadratures; but other observers have drawn opposite conclusions. The results of different years do not correspond. The fault may, in many cases, have lain in the instruments, which, for want of proper care and management, are liable to deteriorate. Considering, also, the many irregularities which attend the moon's motion, it is only by a long series of observations, that correct and satisfactory deductions can be formed. The author describes, at length, the instruments he employed, and the precautions which he observed to ensure accuracy in his observations. He extended his researches throughout a whole *Saros* or lunar cycle, and sums up the result as follows:—

*Table of the mean heights at noon, of the barometer, at the observatory of Viviers, in the phases of the Moon, in the Apogee and Perigee of that luminary, and in the lunistices; deduced from the meridian observations of nineteen years,* (19*th Oct.* 1808—18*th Oct.* 1827.)

| LUNAR POINTS. | Number of observations. | Mean heights of the barometer. | Reduction to millimetres. |
|---|---|---|---|
| | | pou. lig. | m. m. |
| Mean general height, | 6915 | 27 11.29 | 755.44 |
| Conjunction, or new Moon, | 234 | 27 11.27 | 755.39 |
| First Octant, | 234 | 27 11.26 | 755.37 |
| First quadrature, | 234 | 27 11.26 | 755.37 |
| Second Octant, | 235 | 27 10.94 | 754.65 |
| Opposition, or full Moon, | 234 | 27 11.20 | 755.23 |
| Third Octant, | 234 | 27 11.47 | 755.70 |
| Second quadrature, | 234 | 27 11.68 | 756.32 |
| Fourth Octant, | 235 | 27 11.31 | 755.48 |
| Northern Lunistice, | 258 | 27 11.42 | 755.73 |
| Southern Lunistice, | 258 | 27 11.28 | 755.42 |
| Moon in Perigee, (Parall. equa. 60′ 24″) | 252 | 27 10.97 | 754.72 |
| Moon in Apogee, (Parall. equa. 54′ 4″) | 252 | 27 11.46 | 755.82 |

It evidently appears from this table,

1st. That in a synodical revolution of the moon, the barometer rises regularly from the second octant, when it is the lowest, to the second quadrature, when it is the highest; and then descends to the second octant to commence again its rise, &c.

2d. The varying declination of the moon, also modifies her influence upon atmospheric pressure. It is greatest (at least in the latitude of Viviers,) when the moon's declination is south; whence it evidently results that the barometer is higher in the northern lunistice than in the southern. This observation is contrary to what M. de Laplace had concluded from his theory, viz. "that the sign (signe) of the declination of the two luminaries (sun and moon) has no sensible influence on the modifications of the atmosphere."*

3d. Lastly, the action of the moon, in diminishing the pressure of the atmosphere, varies with its distance from the earth. The mean height of the barometer, is less when the moon is in perigee, than in apogee; whence we may infer, that her action in diminishing pressure, is greater in the former than in the latter situation.

There exists between the phases of the moon and the days of rain which coincide with these phases, a constant relation, which would appear very singular, if what we have observed with respect to the barometer, did not furnish an immediate explanation. Agreeably to the extract which I have made from my meteorological journal of the rainy days which coincide with the days of the moon's phases, and with those of the perigee and apogee during the period of nineteen years, I have found the number of those days as follows.

| | PHASES OF THE MOON. | | | | | |
|---|---|---|---|---|---|---|
| | New Moon. | First quarter. | Full Moon. | Last quarter. | Perigee. | Apogee. |
| No. of rainy days coincident with the days of the Moon's phases. | 77 days. | 82 days. | 79 days. | 60 days. | 93 days. | 78 days. |

We perceive by this table, that the number of rainy days which coincide with the days of the phases, &c. follows the same march with the mean heights of the barometer corresponding with these phases, but in an *inverse order:* thus the number of days of new moon on which it has rained, is less than the rainy days of the full moon, and the mean height of the barometer on the days of conjunction, is greater than that of the days of opposition; in like manner, the rainy days of the first quarter, greatly exceed those of the last quarter, and the barometer heights are also inversely correspondent; lastly, the wet days of the perigee are much greater than those of the apogee, and the barometer follows a correspondent change.

We may, therefore, conclude that the diminution of the pressure

* Mécanique celeste, t. ii. p. 298.

of the atmosphere caused by the attraction of the moon, ought to be reckoned among the causes which determine the fall of rain.

[*Ib.*

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*Notice of an instrument denominated the Sideroscope, by which the presence of very minute quantities of iron may be detected.*

An instrument has been invented in France, to which the above name has been given, provisionally, from the extreme facility and delicacy with which it indicates the smallest portion of iron in any substance, mineral, vegetable, or animal.

It consists briefly, of a small straw, nine inches long, through one end of which pass at right angles, two fine sewing needles, sixteen lines in length, both strongly magnetized, weighing only one grain. They are inserted in contrary directions. Through the other end passes a single sewing needle, of the same length, weighing a grain and a half, magnetized in the same manner. This instrument is suspended inside of a glass case, by a single untwisted fibre of raw silk, twelve inches long; substances to be examined, are introduced into the case, by a lateral opening. The whole instrument weighs but four grains, and the utmost care is observed to exclude from the frame or table of wood which supports it, the smallest particle of iron, and to avoid the disturbing effects of a current of air, and even of the breath.—The substances to be presented for trial, are pasted to a small strip of card or pasteboard, to avoid the heat of the hand or fingers.

Almost every piece of money, French or foreign, ancient or modern, gold, silver, or copper, but especially the silver coins of Italy, attracts the sideroscope with greater or less activity: it is the same with all substances, mineral, vegetable, or animal, which contain the least atom of iron, nickel or cobalt. Platina exercises a decided action, notwithstanding all the chemical operations necessary to bring it to a soft state.

Small masses of any of the following substances, weighing at most, eight or ten grains, affect this delicate instrument. All kinds of ashes, compacted by a little gum water; blood simply dried or swelled; chocolate; bottle glass; tourmalines, green and black, not rubbed or warmed; granite; rhomboidal quartz; yellow topaz; green talc; sulphate of iron; all volcanic products; all metals not chemically pure; brass pins, even the finest used by entomologists; various galenas and other minerals; all ærolites; burnt hoofs and horns of cattle, &c.

The most surprising effect of the sideroscope is, the *repulsion* of the needle by bismuth and antimony.

[*Ferrussac's Bull. Juillet*, 1827.

*Notice of a Varnish composed of Copal and Spirits of Wine alone, prepared at Barcelona, in Spain.*

TO THE EDITOR.

Sir,—I send you the following, hoping it may be of service to the public. I cannot aver that there is any thing new in it; that I leave to your better judgment.

Yours, &c.

*Baltimore, Dec.* 11, 1828. R. A. D.

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*Translated for the Journal of the Franklin Institute.*

From the Diario Mercantil, of Cadiz, October 30, 1828.

*Spanish Varnish.*

The formation of a varnish composed of gum copal and alcohol, without the addition of any other substance, has long been the subject of the investigations of the most noted chemists of Europe. As yet, *their* efforts have not been successful.

*Felix Urguelles*, an inhabitant of Barcelona, after numerous trials, succeeded in drawing from the mysteries of nature a secret hitherto unknown—the formation of a varnish superior to any other hitherto made. His repeated trials of this varnish convince him of its superiority. Its principal qualities are, its extreme whiteness; it is so hard, that it resists the action of the sun without cracking; so elastic, that any thing on which it is spread may be doubled, without injury to the varnish. He has applied it with success upon iron and tin, and cups and boxes of steel, hats made of pasteboard, &c. Experiments were made with it before a committee of the Royal Chamber of Commerce of Barcelona, who expressed themselves highly pleased with their results.

*Remarks by the Editor.*—It is much to be doubted whether there is any thing new in the varnish above referred to. If it is composed of the two ingredients named, its toughness must be that which is due to the resin alone, and a varnish of this description has been repeatedly made. Copal has been dissolved both in alcohol and spirits of turpentine, by suspending it in the neck of a matrass, and allowing the vapour from the boiling liquid to come in contact with it. The solution has also been frequently effected, by rubbing up the resin in a mortar, with some of the essential oils, or with camphor; and William Hembel, esq., of Philadelphia, dissolved copal with the most perfect facility, in alcohol which he had rectified with peculiar care. This subject shall be resumed hereafter.

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## AMERICAN PATENTS.

LIST OF AMERICAN PATENTS GRANTED IN OCTOBER, 1828.

*With Remarks and Exemplifications by the Editor.*

26. An improved *Furnace for Melting Cast-iron*, and converting cast into malleable iron, and an improvement in the manufacture of malleable iron; Benjamin B. Howell, Philadelphia, October 11.

The specification, with engravings, will hereafter be published.

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27. An improvement in *Rail-way, and other Carriages*, denominated "Winans' Friction-saving Rail-way Carriage;" Ross Winans, Vernon, Sussex county, New Jersey, October 11.

In the various drawings which accompany the specification of Mr. Winans' invention, several different methods of applying friction rollers, or secondary wheels, as he denominates them, are exhibited. For a common carriage, or gig, a friction wheel is placed on the upper side of the shaft, or in a mortise within it, its axis turning in brasses, properly secured, one of them being fixed over each end of the main axle, just within the nave of the wheel. The axles are retained in their places, under the centres of the friction wheels, by staples, in which they turn freely, and which staples are, sometimes, to be lined with brass. Sometimes two lateral friction wheels are substituted for the staples, so that the main axle is supported by three friction wheels, or rollers. Sometimes two friction rollers are so placed, that their peripheries intersect each other, and in this intersection the axle runs; most of our mechanical readers are familiar with the use of such rollers, in supporting the axes of fly, and other wheels, used in machinery.

For rail-way carriages, the friction wheels are made with a rim, projecting inwards, like the rim on the side of a crown wheel. The ends of the axles of the main wheels, pass within, and rest against these rims. In this case, it is evident that the centre of the friction wheel, will be below the carriage axle. There are brass boxes, or staples, which embrace the main axles, to check that too free lateral motion which would take place, were they confined only by their bearing within the rims of the friction wheels.

In the single-rail-way, as proposed by Mr. Palmer, in England, the load is to be divided into two portions, and suspended in carriages below the wheels; Mr. Winans has given a drawing of the mode in which he proposes to adapt to such carriages, his last described secondary wheels, with a projecting rim.

After discussing at some length the merits of the modes of construction proposed in the specification, the patentee concludes as follows:—

"And I declare the principle of my improvement, machine, or carriage, as aforesaid, and described, to consist in the employment of secondary wheels, bearing the loading on their axles, the peripheries of which secondary wheels, are turned by the revolution of the axle of the primary, or travelling wheels, the main axle thereof, by its gudgeons, or journals, rolling on, or in, the said peripheries when the carriage is moved, thus changing the usual rubbing motion of the main axle to a rolling one, and thus, conveniently, and greatly, increasing the relative leverage between the diameter of the travelling wheels and the axles immediately bearing the load, and thus increasing, greatly, the comparative slowness of the rubbing motion at the bearing axle, compared with the motion of the periphery of the travelling wheels, or progressive motion of the carriage."

28. A microscopic *Pen Machine;* John Bennet, Lowell, Massachusetts, October 11.

The pen is to be cut in the common way, with the exception of cutting the nib, in doing which the machine is destined to lend its aid. A double convex lens is fixed in a brass slide, and under it there is a cylindrical piece upon which to pass the pen, the nib of which is to be cut: this cylindrical piece may be raised or lowered, so as to adapt it to the focus of the lens, when the nib is to be cut with the penknife, as usual.

We are very apprehensive that, like ourselves, the greater number of those persons for whose use the Microscopic Pen Machine is designed, will prefer two double convex lenses fixed in a silver frame, and placed across the nose, as such an apparatus is found to be very convenient in preparing the quill for, as well as in giving it, the final cut.

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29. An improved method of making *Weeding and other Hoes;* James A. Black, Columbia, South Carolina, October 13.

(See the specification in this number.)

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30. Improvement in the machine for *Casting Printing Types*, originally invented by Mr. Wm. Johnson; George F. Peterson, New York, October 13.

(See the specification.)

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31. Improvement in the construction of a *Furnace for Generating Steam by Anthracite Coal*, and for the use of various manufactures requiring intense heat; Benjamin B. Howell, Philadelphia, October 14.

This, as well as No. 26, will hereafter be published, with engravings.

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32. A top press roller, to be attached to the *Machine for making Paper;* Mason Hunting, Watertown, Massachusetts, October 20.

(See specification.)

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33. An improvement in the *Plough;* Stephen M'Cormick, Fauquier county, Virginia, October 22.

The original patent for this improvement, was issued January 28, 1826; but in consequence of defects in the specification, this has been surrendered, cancelled, and the seal broken, and the present patent issued, bearing date with the former.

The specification of the above invention is of considerable length, and the subject not to be understood without the drawings, which, at present, it is not our intention to furnish. There are models in the patent office of about 120 varieties of the plough, varieties, we say,

although in many instances it would be difficult to tell in what the difference between them consists. Mr. M'Cormick's is said to be a good plough, and the improvements which he claims, are,

"*First.* The share, &c.; the bar made thick at the bottom, and thin on the top edge; putting a piece from the point of the share of the plough, up to the point of the mould board; and the application of the improvement in the shoe, to raise and lower behind, at pleasure.

"*Second.* The method in which the mould board is wrought; the shape of its face, or mould part; the curve, or projection over towards the land side; the long hole through its top, for the beam bolt; the catch at the bottom to fasten it to the share; and the concave groove for the handle.

"*Third.* The situation of the fore part of the mould board for the cast share, and the self-sharpening point; the position of the brace bar, between the land side and mould board, for the point to rest on, and to fasten it to; the length of the point, and the manner in which it is fastened to the brace bar; the shape of the share, for the point to rest upon.

"*Fourth.* The shape of the sword with two edges; the manner in which it is fastened to the side of the beam with a staple.

"*Fifth.* The stock; the method of fastening the handle and beam together, with a staple; fitting the handle in the concave groove; and adjusting the beam on the top of the mould board: all of which is fully specified in the foregoing."

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34. Improved mode of *Tanning Belt, or Picker Leather;* John J. Travis, Franklin county, Connecticut, Oct. 22.

The improvement consists in the ingredients used in the tanning; and this it is contrary to our plan to publish.

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35. *Felloes of Cast-iron*, for wheels, trucks, carts, wagons, coaches, &c.; George Andrews, Tolland, Connecticut, Oct. 24.

(See specification.)

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36. *A Percussion Cannon Lock;* Joshua Shaw, Philadelphia, October 24.

This will hereafter be published.

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37. Improved mode of *applying Water to Flutter-wheels;* James Stewart, Robertson county, Tennessee, October 24.

The patentee claims to have "discovered that water possesseth two powers, gravity and velocity," and his improvement consists in uniting them.

We are at some loss in discovering any novelty either in the powers that water possesseth, or in the mode of applying them, and, therefore, dismiss them without further remark.

38. Improvement in the *Hubs and Axletrees* for wheels; Phineas Slayton, Lockport, Niagara county, New York, October 27.

That which is claimed as an improvement in the specification before us, is the invention of rollers within the hub, or nave, of a wheel or pulley, surrounding the axle or gudgeon, so as to lessen friction. It is proposed, sometimes to insert rollers in the under side of the axle, to bear upon the boxes, for the same purpose. Mechanicians know that a patent was obtained by a Mr. Garnett, in England, some forty years ago, for friction rollers, applicable to various kinds of machinery. They were very ingeniously contrived for converting the whole of the rubbing into a rolling motion. In theory, they were excellent, but in practice they were far from fulfilling the promise which they had made. They were found to be altogether inapplicable to carriages, and, indeed, in every case where a rapid motion was required; as the least want of truth in the workmanship, or from wear, caused them to *gather*, and, consequently, to increase the friction which they were designed to prevent. In many instances, the cylindrical roller became a polygon; and, we believe that, excepting where the bearing is short, and wheels, rather than rollers, can be applied, there is no instance of their continued employment.

Many of Garnett's friction rollers have been applied both in England and the United States, to ships' blocks, and other kinds of pulley, and when well made, and properly used, have, of course, greatly lessened the friction.

We leave the claim of utility or novelty in the *invention* of the present patentee, to the test of experience, and to the tribunal to which it most properly belongs.

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39. Improvement in the mode of forming or making *Hat Bodies;* Henry F. West, and Andrew H. Stevens, Richland, Oswego county, New York, October 29.

(See the specification.)

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40. A method of *Propelling Boats;* Stephen Ross, Troy, New York, October 30.

This method of propelling, is intended to be used principally, or exclusively, for ferry boats. A horizontal wheel, with a vertical shaft, is to be propelled by the feet of a horse, in the manner commonly known. A cog wheel, on the vertical shaft, placed below the platform on which the horse treads, turns a horizontal shaft, standing across the boat, and projecting beyond its side. Upon one end of this shaft, and outside of the boat, there is a cog wheel, which takes into two other cog wheels, whose journals are attached to the side of the boat, so that the centres of the three wheels are in the same horizontal line. These wheels have drums, or projections, attached to them, around which a chain, or rope, may pass. A chain, or rope, is to be stretched across the river, and securely

fastened at each end. When the boat is to cross, the chain, or rope, is made to pass over the drums of the two outer, and under that of the centre wheel, on the side of the boat. At each end of the boat there are pulleys, to support and direct the chain. When not supported by the wheels, the chain is of such length, as to lie upon the bed of the river.

Certain provisions are suggested in particular cases, which it is not necessary to notice.

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41. Improvement in the patent granted to Matthew Chandler and Ezra Brown, for *Wire Harness for Weaving;* Ezra Brown, Cazenovia, Madison county, New York, October 30.

(See specification.)

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42. Making paper of the *Husks of Indian Corn;* Andrew and Nicholas A. Sprague, Fredonia, Chatauque county, New York, October 31.

A patent for the same purpose, was granted to Burgess Allison and John Hawkins, December 30, 1802.

We have not examined that patent, and, therefore, do not know what difference there may be in the two processes. The specification of the present patentee, is in the following words.

"To one hundred and twenty-eight gallons of water, put in ten quarts of good lime, or about six pounds of good alkalies, and place therein about one hundred and ten pounds of clean corn husks, or flag leaves; let the water be moderately heated, over a moderate fire, for two hours, when they will be ready for the engine, there to be worked, and managed in every respect as rags are, for the making of paper."

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## Specifications of American Patents.

*Specification of an improvement in the mode of making or forming Hat Bodies. Patented by* Henry F. West, *and* Andrew H. Stevens, *Richland county, New York, October* 29, 1828.

*First.* A complete carding machine, with the exception of the roller and doffer, the doffer being covered with filleting cards, which brings the wool from the machine in a continued web.

*Secondly.* This web alights upon a table, constructed for its reception, about five feet in length, and three in width, with rollers in each end, over which an apron passes, the rollers moving by a band, or by cog wheels, attached to the machine above described, with sufficient velocity to receive the web free from wrinkles, and without stretching it in the least, carrying it from the place where it first strikes, or alights, upon the apron, to the other end, perfectly smooth.

*Thirdly.* From this the web is taken, by a hat former, (this being the only part of the machinery herein described, which the petitioners claim as their invention, together with the manner of using the hat former, and the right of forming hats on the apron and table,) the hat former consisting of a board from three feet to four feet and four inches in length, and from 16 inches to thirty-two inches in width at the centre, according to the size of the hat to be formed; being tapered from the centre to each end, leaving the ends from 5 to 12 inches, which are made round, the board forming, from its dimensions or shape, two hat bodies, one at each end.

*Fourthly.* The web is wound upon this board, by laying the board, or former, upon the table, and rolling it onward, the apron advancing in the meantime: (the board may be previously covered with some kind of thin cloth, from the centre to the ends, which causes the web to cleave to the hat former, the cloth consisting of two pieces, one at each end;) the web diagonally covering the former on all parts, smoothly, as the workman wishes, who turns the former, standing at the other end of the table.

*Fifthly.* After the hat bodies are thus wound upon this board, or former, they are cut, or torn, in the centre, and taken from each end; the cloth may come from the former at the same time, and with the hat bodies, then be taken from them, and placed again around the hat former.

HENRY F. WEST.
ANDREW H. STEVENS.

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*Specification of an improved Top Press Roller, to be attached to the machine for Making Paper. Patented by* MASON HUNTING, *Watertown, Middlesex county, Massachusetts, October* 20, 1828.

1. THE roller, or cylinder, may be made in the usual way and form, and of the usual materials, but of such a size or diameter as will give a sheet of paper of the required dimensions, by one revolution on its axis.

2. A slit or groove must then be cut in the roller, in a straight line from one end to the other. This slit, or groove, may be from one-quarter to half an inch wide, and from one to two or more inches deep. The roller thus constructed, will continue to receive the paper from the felt, when the machine is in motion, till it has revolved a sufficient number of times to give to the paper, or sheet, any desirable thickness, when the person attending will, without stopping the machine, take the sheet from the roller, by applying his fingers to the sheet at the ends of the roller, at the groove, when it will separate along the groove; he will then take it off and place it upon the lay-stool, and in this manner continue the operation.

3. A small bell may be attached to the roller, which shall give notice to the person attending, when the same shall have performed the number of revolutions necessary to give the sheet the requisite thickness.

4. A knife acting on springs, may be placed within the groove to cut or separate the sheet at any given number of revolutions of the roller: or the sheet may be divided by passing a small circular saw, turning on an axis along the groove, by the person attending. It is, however, believed, that taking off the sheets from the roller, by hand, will be the best way.

By means of this improved roller, paper of any thickness may be made by a single and simple operation—where it has been heretofore necessary that a number of thicknesses, or sheets, as they come from the mould, should be pressed together to form one solid sheet or mass; such as paste-boards, playing cards, press papers, book binders' boards, sheathing paper, &c. &c. MASON HUNTING.

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*Specification of an improvement in Felloes of Wheels, for Trucks, Carts, Wagons, Coaches, Chaises, and all kinds of Wheels ordinarily made use of for transporting loads, for pleasure or business. Patented by* GEORGE ANDREWS, *Tolland, Connecticut, October* 24, 1828.

THE rims, or felloes, are to be made of cast-iron, and may be cast whole, or in pieces or segments.

The rims, or felloes, if cast whole, may be used with or without a band or tire, and must be cast with a mortise, open in one side, to receive the ends of the spokes, with a groove to receive a slide to fasten the spokes into the felloes. The slides are to be made of wrought iron, and fastened to the spokes by a bolt, or screw.

The felloes, or rim, to be made with swells where the spokes enter them. The segments are put together and united by a tenon and mortise at the ends, with a small space at the end of the tenon sufficient to receive a bolt to hold the band, or tire. The felloes should be cast with swells in them, where the ends of the segments meet, and a similar swell where the spokes go into the felloes; those swells are designed to give more strength to the wheel. The shape of the felloes may be varied to any that may be wished.

The peculiar excellence of this kind of felloe, is, that it is more durable than wood, not being subject to rot, or decay, by being used, or exposed to the weather; and will remain good as new ones, when the spokes and other parts of the carriage which are made of wood, shall be wholly demolished by age and use, and can be easily obtained when suitable timber for felloes cannot, and can be afforded equally as cheap as those made of wood. GEORGE ANDREWS.

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*Specification of a mode of making Weeding and other Hoes. Patented by* JAMES A. BLACK, *Columbia, South Carolina, Oct.* 13, 1828.

AN anvil with a face ten or twelve inches, by twelve or fourteen inches on the face, on which the size of the blade of the hoe is sunk,

nearly as deep as the hoe blade is thick, with also the thickness of the eye of the hoe spread out flat, sunk in the same. From the centre of the blade to the middle of the eye as thus spread out, the anvil is still deeper sunk, so as to receive the ridge extending from the centre of the blade to the eye of the hoe when made. On this anvil a tilt or trip hammer works, with a face large enough to cover both blade and eye as extended or spread out. This hammer is put into motion in the usual way as now practised in forging iron. The hoe is made from a bar of iron about seven-sixteenths thick, and four, or four and a half, inches wide. The bar is heated and laid on the anvil, the end extending to the edge of the blade, or nearly so, and passing back over the centre of the eye. The action of the hammer forges the iron down into the sunk part of the anvil, until the iron begins to spread over the high part of the face of the anvil, and is made of the proper thickness for a hoe. In this part of the operation, the back part of the blade and the inside of the eye are up next the hammer; the upper side of the blade and outside of the eye next the anvil. The hoe is then trimmed by a pair of shears, such as are used by tin-plate workers, down to the impression made by the sink in the anvil. These shears are worked by a crank on the same shaft that gives motion to the tilt hammer. The hoe is then heated, and the blade part fastened in a vice made for the purpose; one jaw of the vice is flat; the other is formed so as to receive the ridge on the face of the hoe, and the upper part sunk or indented so as to fit the round of the eye. While the iron is at a proper heat, it is turned down to the front, and swedged in to the last described jaw of the vice, so that the eye is brought to form a square with the blade. Then the two wings which form the eye, are turned over so as to lap one over the other on the back, or pole, of the eye, at which place they are welded at a subsequent heat and operation. What is claimed as new and an improvement in the art of manufacturing weeding and other hoes, by this method, is, forging the blades and eye at the same operation, with a tilt hammer, at which time, one side of the hoe and eye is perfectly flat, the other only varied by the different thicknesses required. From this shape, the hoe is completed by squaring the eye to the front, and turning the wings so as to meet and lap over. There are many operations I use which have been, heretofore, practised. JAMES A. BLACK.

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*Specification of an improvement on the patent granted to* MATTHEW CHANDLER *and* EZRA BROWN, *for Wire Harness for Weaving. Issued to* EZRA BROWN, *Cazenovia, Madison county, New York, October* 30, 1828.

WHEREAS, in the original harness, each heddle is formed of two pieces of wire, usually between Nos. 24 and 27, each about ten inches in length, and formed into a staple, by being bent in the centre, the prongs brought parallel at about one-sixteenth of an inch

distant from each other, each end turned inward till it forms three-fourths of a circle, and is brought against the wire, and at right angles with it, forming an eye nearly round, and of a size that would easily admit a rod of the size of No. 12 wire, which rod supports the heddles by being attached to the shaft. In one of these loops, an eye is formed, about three-eighths of an inch in length, and one-sixteenth of an inch in breadth, by twisting the prongs together in a close manner, once and three-fourths round, which places the eye in the proper position to receive the thread by which it is occupied. This is called the eye part, and the other the loop part of the heddle. The loop is put through the eye, and each part extended to its respective rod and shaft.

In the improved harness, each heddle is formed of two pieces of wire bent in the same form as in the original, with the following exceptions and difference. Where the loops are bent in the centre, the prongs are brought parallel, and so close as barely to admit a wire of the same size. In one of these loops, two eyes are formed in succession, the first by twisting the prongs together closely once and a half round, leaving an eye about one-fourth of an inch in length, and in breadth barely sufficient to admit the loop by which it is occupied; the same prongs are again twisted together closely, once and three-fourths round, forming the second eye between this and the first twist, about three-eighths of an inch in length, and one-sixteenth of an inch in breadth, or of such other dimensions, as the nature of the weaving, and general convenience require. This last eye is occupied by the thread. When twisted as above, both eyes range in the same and in the proper direction. The eye part is made about an inch longer than the loop, by which means the eye that is occupied by the thread, is situated nearly at an equal distance from each shaft. In each part, the prongs are prevented from separating apart, by twisting them around each other in a slack manner between the eyes and either shaft.

The signal advantage of this improvement is, that the eye which is occupied by the thread, is not encumbered by the interlocking of the loop, whereas, in the original, the thread is evidently exposed, and frequently broken, by getting fastened between the wires where they lock together.

EZRA BROWN.

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*Specification of an improvement on a machine for casting Printing Types, originally invented by Mr.* WILLIAM JOHNSON, *called a "Type Machine." Patented by* GEORGE F. PETERSON, *New York, October* 13, 1828.

THIS improvement in Johnson's type machine, varies from all others, in the following particulars.

1st. In applying a spiral spring instead of a weight, for the purpose of forcing the plunger downwards.

2d. In having separate chambers in the bottom of the pot, one larger, for the plunger to work in, the other for the stopper-rod.

3d. In having the cap suspended under the pot, on a frame, for the purpose of letting the same rise, and fall, in a position parallel with the top of the mould.

4th. In applying a spiral spring fixed on the connecting rod of the stopper, for the purpose of raising the same; on the lower end of the stopper-rod is a stirrup, surrounding a wheel with an indentation; a pin is fixed in the bottom of the stirrup, falls into this indentation at every revolution of the axis, when the mould is brought up against the spout, thereby permitting the stopper to be raised while the metal is forced into the mould.

5th. In using a perpendicular movement, by which the mould is drawn from the spout, and kept in a horizontal position, which is obtained by means of a sliding frame, in which the mould-bed is hung. To the sliding frame is attached a perpendicular rod, on which plays a slide, to which is joined a shakle bar, passing obliquely, and connected to the end of the mould-bed, next the mould; the slide and perpendicular rod, are put in motion by the main lever. The sliding frame is raised when the mould-bed has attained a horizontal position, by the slide on the perpendicular rod striking a fixed collar, and is brought down again, by a lever connected with the collar, by an arm on the axis.

6th. The permanent frame in which the sliding frame moves, is fastened on a circular plate, through which, and the permanent frame, the perpendicular passes.

7th. The improvement in opening and closing the mould, consists in using a spiral spring, to give pliancy, so that the mould may accommodate itself to different thicknesses of matrixes, which is obtained in the following manner. Two cylinders are placed on the mould-bed, one within the other; through the inner one, passes a rod surrounded by a spiral spring. The rod is continued out at both ends of the cylinders. The outer cylinder is slit, exposing to view the inner one, which is connected to a lever by a rod having two regulating nuts. To the end of the rod next the mould, is fixed a plate which is attached to the back of the moving half of the mould, but borne off by an intervening spring, to give pliancy to the mould —through the fixed plate is a regulating screw, operating on one end of the intervening spring.

8th. The permanent side of the mould is fastened to a shank, which is hollow, to afford a passage for water.

G. F. PETERSON.

*Specification of a patent for an improved Rail-way Carriage. Patented by* WILLIAM HOWARD, ESQ. *of the city of Baltimore, United States Civil Engineer, November* 22, 1828.

(WITH THREE COPPER PLATES.)

BE it known that I, the said William Howard, have made, invented, constructed, and experimentally applied to use, a new and useful improvement in the construction of carriages, intended to travel upon rail-ways, called by the name of "the Improved Rail-way Carriage," specified in the words following: that is to say, To render more useful the establishment of a rail-road through a broken country, it has been a desideratum to construct a carriage which shall move with as much facility upon a serpentine, or curved, as on a straight road, and, at the same time, not to lose the peculiar advantages which the common method of fixing the wheels on the axis, possesses. It is also desirable to lessen, if possible, the amount of friction, by means not too complex for general use. These two ends, it is proposed to attain in the construction of the wagon hereafter described, upon the principles now set forth. These principles are as follows.

1st. The connexion of the two beds of the axles at a point equidistant from each; and in the same manner the connexion between the hind bed of one wagon, and the fore bed of that following it, or the fore bed of the leading wagon with any system of guide wheels, so that the wheels, not only of one wagon, but of a train, will follow one another in the same curve, without more lateral friction than when on a straight line.

2d. The making the axle revolve in its journals, and at the same time rendering either one or both wheels capable of revolving independent of the axle, as in a common carriage.

3d. The application of a simple friction wheel, to diminish the friction of the axle on its journal.

To explain these principles in detail,

1st. If there be a track of a rail-road of a circular form, and we wish a carriage to move on it without lateral friction, the planes of the wheels must be parallel to the tangents of the two circles at the points where they rest on them, and each axle, consequently, in the direction of the radius of the circle. To find the point at which the axles must be connected to produce this effect, draw a perpendicular from the middle of each, and the intersection of these two perpendicular lines will be the point of junction required. The advantage of this over the common construction, is, that there the pivot of the beam connecting the axles, is on the foremost axle, and, consequently, in turning, the hind wheels do not follow the tracks of the foremost ones, but describe a curve of smaller radius, causing great lateral friction on the rails.

2d. The principle of making the wheels revolve with or without the axles in the present case, is, to secure the advantages of the axle

generally revolving with the wheels, and at the same time to permit one wheel to revolve faster than its fellow, when moving on a curved part of the road. The trifling relative movement which this would produce between the axle and the wheel, would admit of these being adapted with considerable exactness.

3d. In the application of the friction wheels, instead of an axle resting on the summit of a wheel, as is the usual method of application, and the only one known to the inventor, the wheel with its load is here made to rest upon the axle.

According to these principles, the combination of which, into a rail-way carriage, forms the ground of the patent claimed by the inventor, the carriage itself would be constructed as follows.

The size of the wheels, their distance apart, and the distance between the axles, are in the common proportions used in rail-way carriages. The connecting beam between the fore and hind axles, is fastened firmly thereto by jaws or frames, to prevent lateral motion. This beam is divided in the centre between the axles, one end having a tooth, and the other a socket, cut of the epicycloid form, to keep the point of action at an equal distance from the centres of each axle. The axles are kept together by fastening the body by bolts to the beds resting upon each. Another method of construction, is, to extend the beam from the hind axle, until the end of it rests upon the bed of the fore axle, while the beam from the fore axle reaches to a short distance only behind the central point of action. A bolt then passed through the centre of the hind frame and the end of the fore frame, and equi-distant from the axles, forms the pivot or point of action between them. In this case, the wagon is fastened firmly to the hind bed only, and to the extremity of the hind beam, which rests on the fore bed, which is made to traverse, laterally, more easily by a small roller upon a curved strip of iron.

The friction wheels are contained between upright stands, or supports, of cast or wrought iron; each wheel having one on each side connected at the top by a bolt and nuts, and having jaws at the bottom, wide enough to admit the axle in contact with the friction wheel; each pair of friction wheels is connected by iron bars passing through each arm of the jaws of the supports, and secured by nuts: between these bars the axle revolves, and the bars rising above the axle, receive the beam, and form the fore and hind beds to which the frames of the beam are securely nutted. To obviate the little friction which may arise from the centre of the friction wheel being directly above the centre of the axle, it may be placed a little obliquely, and a small friction roller used in one of the arms of the jaws, to destroy the additional friction there.

The axles have two shoulders at each end, one of which supports the wagon wheel, and is either firmly fixed to it, or only secured by a linch-pin; and the other revolves upon the friction wheel.

These principles are not new, but the combination of them into a rail-way carriage is new, and entitles, the inventor believes, that his invention be secured by patent. The peculiar application of friction wheels, is also new, and claimed as original.

WILLIAM HOWARD.

*Description of the Plates.*

Fig. 1. Represents a side view of one of the carriage wheels with its friction wheels attached.

Fig. 2. Is a view of two fore, or two hind, wheels, with the friction wheels, showing the manner in which they are connected.

Fig. 3. Represents the plan of the wagon, showing particularly the manner in which the beds of the two axles are connected. In these three figures the same letters refer to the same parts. A, is the iron wagon wheel, made as usual, except that it is arranged so as to turn on the axle to which it is secured by the linch-pin B, or any other contrivance. C, is a wheel fixed upon the axle as in the common rail-road carriage. D, D, the friction wheels moving upon the axles E, E, and supported by the supports F, F. The whole of these parts are of wrought or cast iron, and the frames are secured together by screws and nuts, so as to keep them solid, and as shown in the figure. G, one of the bars connecting the two frames together, and secured in like manner. H and I are the two frames by which the two beds are connected by a bolt at the point K, equi-distant from the centre of each axletree, the frame I of the hind bed is prolonged, and rests on part of the frame H, immediately over the fore axle, the motion of its end, laterally, being facilitated by a small roller at L.

Fig. 4. Represents the axle detached from the wheels and frames; the shoulders P, bearing against the inside of the frame, keeps the axle in its place.

Fig. 6. Represents the shape of the frames F, F, permitting the axle to rest on the periphery of the friction wheels. In the arrangement here drawn, it is proposed to fix, firmly, the body of the wagon on the hind bed and frame L, to move with it. Another method is, to attach each bed to the body by a bolt at M and N, (fig. 5.) round which the beds must be made to traverse. The frames are then to be connected at O, one having a tooth and the other a socket. These are to be cut of the epicycloid form, which will keep the point of action at an equal distance from each of the centres M and N.

If it be not found objectionable to place the body of the wagon entirely above the wheels, the two friction wheels on one bed may be placed on a common axle. This arrangement will simplify the number of parts, and contribute to the steadiness of the motion.

Plate III. is a perspective representation of the whole carriage.

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## *Observations upon Rail-roads, and the adaptation of Carriages to such as are curvilinear.*

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

The prospect of a speedy introduction of rail-ways into this country, has very naturally led to the inquiry, whether they be not

Fig. 1

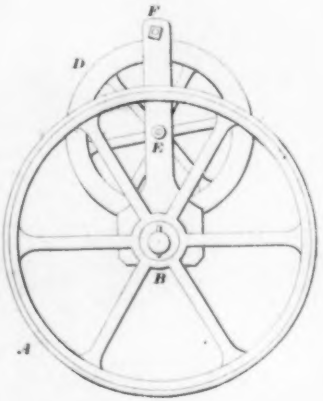



Fig. 2

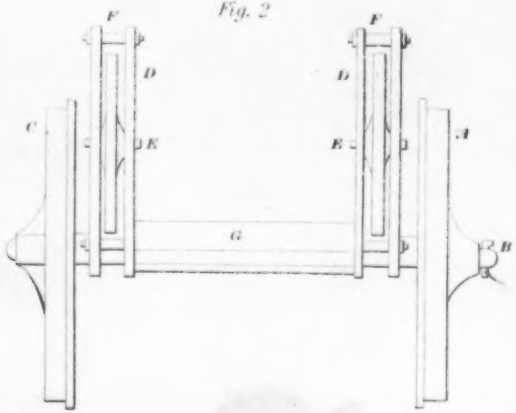



Fig. 4

Fig. 3

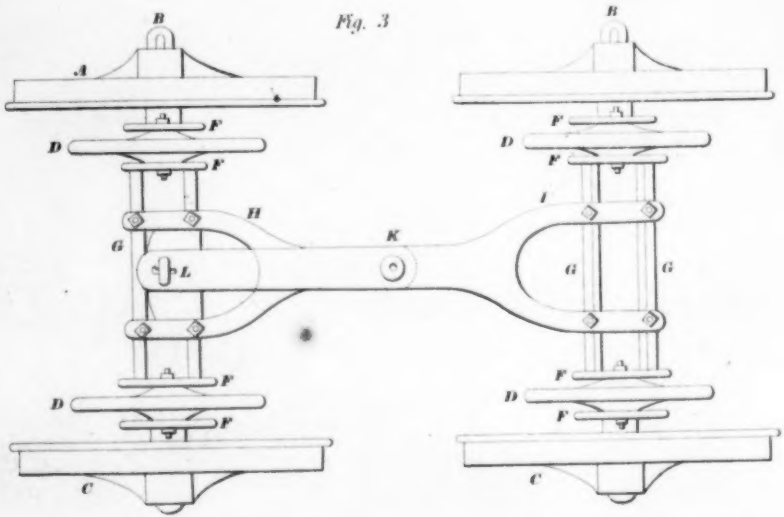
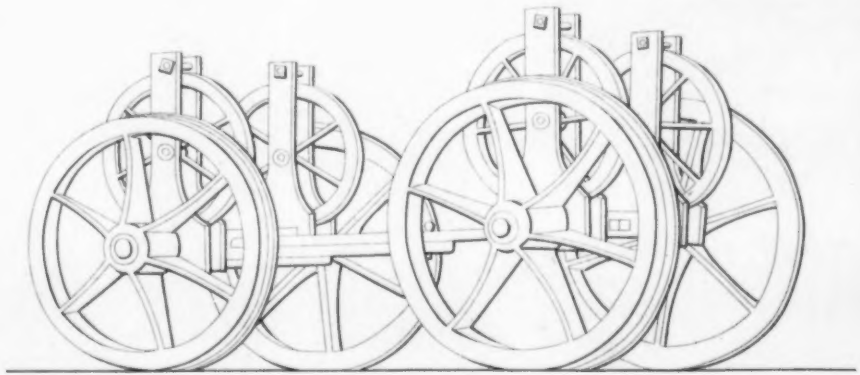



Fig. 5

Fig. 6

# HOWARD'S RAIL-WAY CARRIAGE.





susceptible of improvement. Among other imperfections in the present mode of construction, it is said that there is a continual rubbing of the wheels of the carriages against the sides of the rails, which causes considerable resistance, especially if the track of the rail-way deviate from a straight line. It has seemed to me, so far as I can judge from a description of the machinery, that the objection is well founded. All unnecessary friction and resistance, ought certainly to be avoided; and with a view to that object, I take the liberty of suggesting an improvement in the mode of constructing the rails, and carriages.

In the first place, I would adopt the edge-rail, as it is called, and give it a conical shape; and the wheels of the carriages should have, at their periphery, semicircular channels or grooves, of larger dimensions than the rails, as represented in Fig. 1; *a*, being the rail, and *b*, a section of the wheel resting upon it.

Fig. 1.

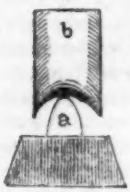
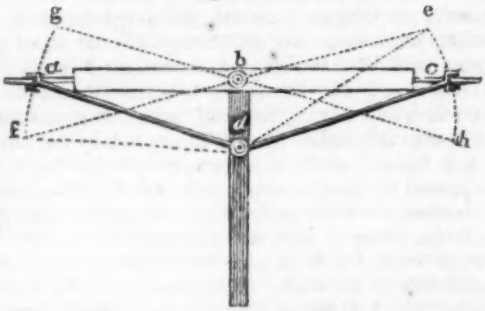



Fig. 2.




In the next place, if the rail-way should deviate from a straight course, I would have the axletree of the forward wheels moveable, upon a pivot at the centre, as in common wagons or coaches. In order to cause this axletree to turn upon the pivot, and to adjust itself according to the direction, or course, of the rail-way, several plans might be adopted. I will suggest a single contrivance, by which the effect may be produced. Let there be moveable knobs or shoulders on the axles of the forward wheels, against which the hubs of the wheels may press: and let there be an arm or lever extending from each shoulder to the body of the carriage, at a point just behind the pivot of the axletree. These arms or levers should be held at each end by a pin, upon which they may turn. When the carriage comes to a curve in the rail-way, if it be to the left, the right wheel will be pressed against its shoulder, which will cause the axletree, by means of the arm or lever, to turn in the direction of the rail-way; and so, vice versa, when the rail-way bends to the right.

In order to illustrate the subject, let *a*, *b*, *c*, Fig. 2, represent the axletree, *b*, the pivot upon which it turns, *a* and *c*, the moveable shoulders, and *a*, *d*, and *c*, *d*, the arms or levers. Now, it must be obvious, that when the rail-way bends to the left, the right wheel will

press against the shoulder *c*, and cause the axletree to turn in the direction of the rail-way, as represented by the dotted line *e*, *b*, *f*.

Friction may be avoided, and some other advantages may, probably, be gained, as it seems to me, by fixing to each wheel a short and separate axis, which shall revolve with it, the whole to be constructed like the wheel of a wheel-barrow. B.

*Petersham, Mass., November* 22, 1828.

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## *On Explosions in Steam Boilers. By the* EDITOR.

THE following notice of an explosion in a steam boiler, recently appeared in the Pittsburg Gazette, and has been republished in most of the papers in the union.

"*Explosion.*—On Tuesday night, about nine o'clock, one of the steam boilers of the Union Rolling Mill, (iron works,) at the eastern extremity of Pittsburg, on the Monongahela river, burst, with a tremendous explosion, shot off through the air at an angle of about 45 degrees with the horizon, and describing a beautiful arch, fell into the river nearly two hundred yards from the works. The steam being on fire, and issuing from the boiler in a stream of flame, it was beheld with astonishment and admiration by the passengers on board the new steam boat 'Uncle Sam,' which had but a few moments before passed the spot where it descended. The furnace in which the four boilers were situated, being without the wall of the main building, under a slight shed, and the exploding boiler taking a direction outward from the works, no other injury was sustained, than the present loss of the boiler itself, and the displacing of its three companions, which it threw entirely out of their bed, and beyond the floor on which it was erected. The rolling apparatus alone, is stopped by the accident; the hammers and other works were in operation as usual, on Wednesday morning."

With respect to the cause of such explosions, there is not, by any means, a concurrence of opinion, even among scientific men; and the manifest importance of the subject, renders valuable every new fact relating to it, which can be established upon incontrovertible evidence. That highly elastic steam will cause a boiler to burst, and that most of the accidents of this kind which occur arise from the want of strength in the boiler, or the imprudent confinement of the steam, is admitted on all hands; but it has been believed by many, that in those tremendous explosions which occasionally occur, such as that above recorded, the exploding agent is, in part at least, a mixture of those gases, whose bases combine and form water, and that there is an actual combustion of these within the boiler. For ourselves, we have never for a moment entertained such an opinion; and, although we have found among its advocates, some persons not unacquainted with chemistry, we have never met with, or been able to elicit, any admissible rationale of the formation of such a mixture; nor do we recollect among the accounts of such explosions, which

have appeared, any one, excepting the foregoing, which seemed to justify the opinion of a gaseous combustion. Whether the evidence in the case before us possesses sufficient strength to add probability to this opinion, we shall presently inquire.

In our second volume, page 147, there is a letter to the Editor, from Professor Hare, in which he has examined this subject, and drawn the conclusion, that the production of explosive gases, is contrary to the well established principles of chemistry. To this article we refer our readers.

A valuable paper, by Mr. Perkins, on the same subject, may be found in our third volume, p. 417. We thought that there was great force and consistency in the theory of that gentleman, and we have not yet seen any reason to change this opinion. We do not think it necessary to repeat what was there said, as it is in the hands of our subscribers; those who feel an interest in the inquiry, may turn to it with advantage.

In the Pittsburg account, the idea of the burning of the steam, is no more rational, than would have been the apprehension that it might "set the river on fire." Steam is as incombustible as water; indeed, it is water in an attenuated state. The opinion, that steam itself burns, when water is thrown upon combustibles, appears to be one of those vulgar errors, which are the result of trusting too much to the senses; those principal, but often false, guides of the uninformed. When water in moderate quantities is thrown upon a brisk, and flaming fire, it is converted into steam, which, expanding and mixing with the flame, causes it to spread out into a much larger volume than it would otherwise have occupied, and thus *apparently* increases the combustion. If it acted in any other way than that stated, the water must be decomposed and recomposed at the same instant; and how, in that case, it could increase the heat, we should be puzzled to tell.

Passing over the statement of the burning of the steam, as only evincing a deficiency in chemical science which is by no means extraordinary, or disreputable, we can well imagine how the appearance of that combustion was produced, which, had it really existed, would have proved the formation of explosive gases within the boiler. We are of opinion that the boiler was heated to redness at one end, and that the meteor-like appearance which it exhibited, was merely the rapid passage of the projected boiler through the air. To the eye, this, like the whirling of an ignited coal, would present a lengthened stream of light, and apparently justify the conclusion that there was a real combustion.

Had this accident, or any of those similar to it which have occurred on board of steam boats, been the consequence of the combustion of explosive gases, a volume of flame would have filled the vessels; linen, and other light articles, would have been set on fire, and persons, instead of being scalded by steam, would have been scorched by fire.

As regards the force of the explosion, there is no reason why it should not have been produced by steam alone. If the steam gun

constructed by Mr. Perkins, should never be brought into actual use, it will have evinced, experimentally, that projectiles may be thrown by the elastic force of dense steam, with a power equal to that of gunpowder. It is not necessary, therefore, in order to account for the effects produced, to resort to any other agents than those which are known to be present, heat and water.

If we ever devise means for obviating such accidents as those of which we have been speaking, we must first acquire correct information respecting the facts attending them, and not adopt vague assumptions, as admitted truths; we must either proceed upon established principles, or discover reasons for correcting our theory. Before assuming that the ignition of gases is concerned, let us hear how these gases are produced. If the oxygen of the water could be made to combine with the iron of the boiler, the hydrogen would be altogether incapable of producing an explosion, without admitting a large portion of atmospheric air; which air must find its way into a vessel in which there was a large quantity of vapour and gaseous matter in a state of tension, and exerting a pressure outward, much greater than that of the external air.

It is believed that these violent explosions take place only when the boiler is without its proper supply of water. If such be the fact, the desideratum is the means of always furnishing this supply; an object which does not appear to us to present any insurmountable difficulty.

We invite attention to this subject, and particularly desire of those who have studied chemistry, and who advocate the opinion which we have opposed, to explain the process by which they imagine a boiler can become charged with oxygen and hydrogen, or any other explosive mixture of gases.

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## Franklin Institute.

*The Twentieth Quarterly Meeting of the Franklin Institute was held at their Hall on the 15th January*, 1829.

James Ronaldson, Esq. president, in the chair, and

William Hamilton was appointed secretary, *pro tem.*

The minutes of the last quarterly meeting, and also of the meeting held this day at 4 o'clock, to appoint the tellers of the annual election, were read and approved.

The quarterly report of the board of managers was read and accepted, and on motion referred to Messrs. S. V. Merrick, Walter R. Johnson, and Thomas Fletcher, as a committee to publish such parts as they may deem expedient, in the Journal of the Institute and the public papers.

On motion, it was unanimously

*Resolved*, That the board of managers, in assuming the publication of the Franklin Journal, as the Journal of this Institute, have, in the opinion of this meeting, acted in strict conformity with the in-

terest of this society, and that their proceedings in this matter be, and the same are, hereby approved.

The tellers reported the following gentlemen as duly elected officers of the Institute, for the ensuing year, viz.

PRESIDENT, James Ronaldson.

VICE PRESIDENTS, { Isaiah Lukens, Thomas Fletcher.

RECORDING SECRETARY, Algernon S. Roberts.

CORRESPONDING SECRETARY, Isaac Hays, M. D.

TREASURER, Samuel V. Merrick.

MANAGERS.

| | |
|---|---|
| John Harrison, | Mordecai D. Lewis, |
| Abraham Miller, | Charles H. White, |
| Isaac B. Garrigues, | George Fox, |
| Adam Ramage, | Andrew Young, |
| Ashbel G. Ralston, | Christian Gobrecht, |
| Rufus Tyler, | Thomas Scattergood, |
| John Struthers, | Thomas M'Euen, M. D. |
| John O'Neill, | Thomas Loud, |
| M. W. Baldwin, | James Rowland, jr. |
| Joseph H. Schreiner, | Frederick Fraley, |
| Samuel J. Robbins, | Benjamin Reeves, |
| Henry Horn, | William Yardley, jr. |

JAMES RONALDSON, *President.*

Attest, WILLIAM HAMILTON, *Secretary, pro tem.*

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## *Fifth Annual Report of the Board of Managers of the Franklin Institute.*

To the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, the Board of Managers make the twentieth Quarterly Report.

IN surrendering to the Institute the powers delegated to them, it may not be improper for the board to take a brief review of their transactions during the past year, without confining themselves to the last quarter only.

When the Franklin Institute was first projected, its founders opened a field for its influence, varied and extensive; embracing, as they thought, all the objects which came within their view, as tending to benefit their fellow mechanics, for whose use and welfare it was organized.

In common with all new and popular institutions, at their commencement, the zeal of those intrusted with its concerns, prompted them to devote more time to its interests, than, in just accordance with their private duties, the infant institution was entitled to.

When once firmly established, and the extent and laborious nature of their duties became known, the board were induced to look for some means, by which their personal attention to the various details necessarily growing out of so large an institution, might, in some

measure, be dispensed with, while their energies would be more directly employed in forwarding its interests, without abstracting too much from their own time.

With this view, in the fall of 1825, they employed a clerk, whose duty it was to keep the records of the board, of committees, and assist the treasurer.

After two years' experience, it was found that this officer could not fulfil the intent of the board, for, although his duties were executed as required, he could not, without devoting his time exclusively to the Institute, perform any service to the treasurer, who, for several months in the year, was liable to be employed in the service of the Institute, at any moment during the day, and the treasurer could not command his own time. After due consideration, the board determined that the affairs of the Institute could not be performed, with justice to its best interests, without the whole time being devoted to them, of some one well qualified to the office, whose feelings toward the Institution would prompt him to take an interest in its prosperity, from other motives than the mere compensation he might receive.

They, therefore, determined to create an officer called the Actuary, whose duty it should be, to act as secretary to the board and standing committees, in conjunction with the curators, to have charge of all property of the Institute, collect all money due the society, and account for the same, and in compensation, to receive a commission on all receipts into the treasury.

The board selected, in April last, for this important and responsible office, Mr. William Hamilton, a gentleman well qualified for its duties, in the performance of which they have every reason to be well satisfied.

The sources of compensation above stated, from the funds of the Institute, it must be evident, could not be a remuneration to any gentleman devoting his whole time to its service; the board were, therefore, obliged to seek some other source, from which they might obtain the means for this object, and at the same time extend the benefits of the institution.

The publication, by the Institute, of the Franklin Journal, appeared the best calculated to effect their object, and was, therefore, under agreement with the editor, assumed, not under the expectation of profit, but with the double object of furnishing compensation to the actuary, and increasing the library of the Institute, by exchanging with other periodical publications.

After a trial of one year, although the accounts are not yet closed, little doubt remains but that the Institute will suffer a small loss by the operation.

Your board, however, are of opinion, that this loss has been amply repaid by the advantages the society have gained, first, in the services of the actuary, and secondly, in the increase of the library, for which they exchange with 12 periodicals. They have, therefore, determined on its continuance, and beg leave earnestly to recommend to the Institute, that it receive their cordial support. This work, originally published by Dr. Jones, under the patronage of the

Institute, has completed six volumes, and the board do not hesitate to say, that no work devoted to mechanics has ever, in this country, taken so high a stand among its cotemporary periodicals. The abilities of the gentleman who edits it, are known to you all; and since he has been called to take charge of the patent office, at Washington, and his means of information extended, a marked improvement has been visible on its pages.

The editor's official station, gives him an opportunity of noticing all patents which are taken out, and this is done without filling the work with useless legal or technical verbiage; but by an abstract of the specification, sufficiently voluminous for a just knowledge of the invention described, accompanied by the editor's remarks, supplied from a fund of mechanical information, surpassed by few. That the character of the work will rapidly improve, there cannot be a doubt, when it is recollected that it has only been a few months since the editor has become settled in his new abode, and enabled to systematize his own time and operations.

With a view of more distinctly identifying the journal with the Institute, the board have resolved to alter its title, and, hereafter, it will be published as the *Journal of the Franklin Institute*, of the state of Pennsylvania, devoted to the mechanic arts, manufactures, general science, and the recording of American and other patented inventions, new series, edited by Dr. T. P. Jones, published by the Franklin Institute, at their hall. Thus the journal becomes identified with the Institute, and it behooves all those who take an interest in its prosperity, to assist in the support of their journal, not merely in a pecuniary way, by subscribing, but intellectually, by lending their aid to increase the interest in its pages. Such a work coming from an institution bearing so high a character as the Franklin Institute, ought not to depend on foreign journals for matter to fill its pages. It is never to be expected that an editor can furnish matter for a periodical, from his own pen; and that the work has not, heretofore, maintained the character of originality, is our fault, not his. The board confidently call on the Institute, to make this work what it ought to be, an original work of the highest standard. Every step of its advancement tends to shed additional lustre on the institution that produces it. Let it be *emphatically, the Journal of the Franklin Institute.*

Since the period for which your board have had charge of the affairs of the Institute, they have been deprived of the services of their able professor of Mechanics, Dr. T. P. Jones, so well known and respected by all for his urbanity and gentlemanly deportment, whose zeal for the cause of mechanics, was only surpassed by his knowledge, from which the Institute drew forth abundantly. His situation has been filled by W. R. Johnson, A. M. the present winter, to whose instruction no one can attend without interest and profit. The board consider themselves fortunate in being able to fill this vacancy so worthily, and with so much satisfaction to the attending members, of whom there is an unusually large class.

The regular lectures by professors Bache and Johnson, com-

menced on the 19th of November, and with a view of enhancing their value to the minor class, a regulation has been adopted, the benefit of which is found to be great. Heretofore, the hall of the Institute has been opened for the small sum of one dollar each to the sons and apprentices of members. This regulation, intended as a benefit to the rising generation, proved a nuisance; for while a part of the lads paid attention to the instruction offered them, very many made the lecture room a place of amusement, to the annoyance of the older part of the audience. To avoid this difficulty, it has been made a part of the course of instruction for each professor to examine, before the lecture, the lads indiscriminately, on what they have learned the lecture previous. Thus an honourable emulation is excited among them, and instead of a place of amusement, the hall of the Institute has become to them what it ought to be, a place of instruction. To assist the pupils, the board have adopted Conversations on Natural Philosophy and Turner's Chemistry, as text books, and recommended them to the lads.

The volunteer lectures have been maintained with spirit and interest. To Peter A. Browne, Esq. the Institute are much indebted for a course on geology, which that gentleman is now engaged in delivering on Saturday evenings. Geology is a subject which he is well qualified to teach, and one of peculiar interest at this moment, while a proposition for a geological survey is now before our state legislature; the plan, of which Mr. Browne is the author, deserves the particular attention of all who take an interest in the welfare of the state. The result of the survey will be, if completed, to lay open the mineral resources of our state, and exhibit the exhaustless riches which nature has bestowed upon us, and give a proper direction to those energies employed in their development.

Mr. Leib has delivered several lectures on mathematics and perspective, subjects of deep interest to every mechanic. They were heard with pleasure and gratification by his numerous auditors.

The drawing school, under the charge of Messrs. H. Bridport and George Strickland, has presented gratifying results; 30 to 40 students being in regular attendance.

The mathematical school was recommenced in November, under very favourable auspices, by Mr. Sears C. Walker, a gentleman highly recommended for his abilities. The number of scholars has not been reported.

The High School continues to enjoy an increased share of public favour. There are, at present, near 200 scholars within its walls, whose rapid improvement evinces the excellence of their instruction and utility of the system. For details respecting this school, reference is made to the committee of instruction, under whose care it more especially is, and who will report after the examination, at another season of the year.

Of the 5th annual exhibition, which was held at the usual season, the board refer you to the report of the committee read at the last quarterly meeting. The detailed report has been delayed, from

causes beyond their control, but it is now in a state of forwardness, and arrangements for its publication will be early made.

To the library of the Institute, several valuable additions have been made, of periodicals, and two works of importance, the Encyclopedia, Manufactures et Arts, and Encyclopedie Arts et Metiers, received from the Academy of Natural Sciences, in exchange for some duplicates. To this branch of the Institute, the board call your particular attention, and that of their successors.

That it has been so much neglected, is attributable to the want of means within the command of your officers, which would enable them to place it on a respectable footing. The opportunity for a gradual increase is now within our reach, through the medium of the journal. The board regret to state, that no donations of value have been received during the past year, but hope when the nucleus now formed shall be properly arranged, additions from this source may be received. The library of the Franklin Institute is of great importance, and, as such, should be carefully nurtured.

For the cabinet of minerals, a case has been provided, through the liberality of Dr. J. R. Coxe, and the collection belonging to the Institute, placed under the charge of professor Bache, who has volunteered to arrange them. The collection is yet small, but contains many important specimens.

The most valuable of the Institute's models, are in good preservation, and arranged in the third story. Those of the several orders of architecture, have been injured; but the committee have taken measures for their restoration, and when repaired, will be placed in safety.

Owing to the dissatisfaction expressed by the Circuit Court, occupying the second floor, at the manner in which the girders were sustained, the board have caused each floor to be supported by four substantial cast-iron columns. Those in the lecture room, resting on birch piers, from the cellar, and each standing on a cast-iron base, 14 inches square. The building is now rendered entirely free from the slightest suspicion of insecurity.

Your board have also caused the railing in front to be finished, which entirely removes the nuisance complained of in the alley ways. Some further improvements will be necessary, next spring, as the paint in the interior has become discoloured and the plastering tarnished. These details they recommend to the attention of their successors.

The treasurer's annual report, is herewith presented; balance, $183 49.

The board now beg leave to surrender into the hands of their constituents, the powers delegated to them, in the hope that the acts of their administration will meet your approbation.

All which is respectfully submitted by order of the board,

SAMUEL J. ROBBINS, *Chairman.*

WILLIAM HAMILTON, *Actuary.*

*Philadelphia, January* 15, 1829.

### *On the conversion of Cast-Iron into Plumbago, by the action of the Pyro-ligneous Acid.*

Mr. W. H. Pepys lately exhibited to the Editor, a piece of cast-iron pipe, which had become completely converted into a substance greatly resembling plumbago or black lead, as it was soft enough to be readily cut by a knife, and would make dark shining traces upon paper; Mr. Pepys said the change was effected by the action of the pyro-ligneous acid upon it. A similar fact has, still more recently, been mentioned to the Editor, by Mr. Evans, of Queen Street, Cheapside; who, in his patent process for roasting coffee, in driving off the acid vapours, at first employed cast iron pipes for conducting them away, and discharging them into the atmosphere; he, however, found that these pipes became converted, by the action of the hot acid vapours, into plumbago; and, in consequence, he has been obliged to substitute, in place of them, earthenware pipes, made of the Vauxhall ware, and which answer perfectly. [*Tech. Rep.*

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### *On distilling Alcohol from Blackberries and Raspberries.*

Mr. Evans lately showed the Editor a specimen of very fine, and pure alcohol, which he stated he had distilled from a very common and well known English vegetable, which he had never before known to be applied to this purpose. The alcohol had the flavour of French brandy. Mr. Evans said, that an experiment was now making, on a large scale, in North Wales, to cultivate the bramble for this purpose; that it readily grew from cuttings planted in a good soil, and which produced fruit the same year; they were to be trained on low frames, to prevent them from trailing upon the earth, and the berries were greatly increased in size from the culture. He does not intend to patent his discovery, but to exercise it for the public benefit.

We think that the raspberry, particularly the large Antwerp varieties, would, also, answer exceedingly well for this purpose, as the fruit they produce, contains a great abundance of saccharine matter. [*Ib.*

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### LIST OF FRENCH PATENTS

*Granted in the last quarter of the year* 1827.

To Souffrant, Barthelmi, mechanic, of Paris, for a pump he calls a French pump, to supersede steam engines—15 years.

To Fastemain, Pierre Nicolas, of Sononches, for a reaping machine—15 years.

To Bourrouse de Laffore, Joseph Bonaventure, of Agent, for a process to learn to read in a short time, he calls "Stateligie"—10 years.

To Bn. Cagnaird de Latour, of Paris, for a process to apply the several sorts of Lava, to purposes as yet unknown—15 years.

To Capdeville, Charles Antoine, of Lugos, for improving cast-iron by employing raw heath root—10 years.

To Spiller, Joel and Crespel, Delisse, Louis Francois, Xavier Joseph, of Paris, for employing steam in the manufacture of beet-root sugar—5 years.

To Cleusman, Jean Baptiste, of Paris, for a piano, wherein the pins and dampers are different from other pianos—5 years.

To Lepine, Jaques Nicolas, of Paris, for a portable gas apparatus —10 years.

To Segundo, of Paris, for improved bits for horses, &c.—10 years.

To Petite Pierre, Jean Henri, of Paris, for a metotachygraphique mould box to cast characters for music—15 years.

To Aschermann and Perrin, Paris, for a cutting machine to shave the hair from hides for hat manufacturing—10 years.

To Louis Junior, Francois, of Nimes, for improvements in the looms, "a la jaquart"—10 years.

To Lebarby Pierre, of Paris, for a means to suspend and prevent ruptures—10 years.

To Muirial Etienne, of Lyon, for woven stuffs imitating engravings, typographies, &c.—10 years.

To Conrad, Philippe Henri, and Adhemar Louis Joseph, of Paris, for a process to manufacture bricks—10 years.

To Steininger, Francois, of Paris, for a mechanism principally applicable to the bass-viol—5 years.

To Didot, junr. Firmin, of Paris, for a process he calls lithotypographique, to print with moveable letters—5 years.

To Lorget, Albert Louis, of Paris, for a process to manufacture paper imitating enamel—5 years.

To Leistenshneider, Ferdinand, of Poncey, for manufacturing paste-board—5 years.

To Bourquin, Abraham Henri and Company, of Lyon, for a mechanical weaver's shuttle—5 years.

To Mallic, Charles, and Memo, Fleuri, of Lyon, for a mechanical loom batt, in weaving ribands, &c.—5 years.

To Berthet, Claude and Cacheux, Victor, of Paris, for a clock escapement—5 years.

To Beauvais, Francois, of Lyon, for a metallic composition he calls "argyroide," susceptible of the polish of steel—5 years.

To Saint Maurice Cabang, of Paris, for a copying press, or secretary—5 years.

To Rodier, junr. Denis, of Nimes, for processes to give various workmanship to silk, wool, and cotton—15 years.

To Mialle Simon, of Paris, for a method to teach to read in a few lessons—15 years.

To Dumoutier, Bon Pierre, of Pantin, for manufacturing hydraulic lime—15 years.

To Montagny, Jean Pierre, of Paris, for manufacturing buttons of all colours and dimensions, imitating silk buttons—5 years.

To Lepine, of Paris, for a horse collar and saddle—5 years.

To Boutain, Charles Toussaint, of Paris, for double spectacles, he calls "binocle a tirage simultane"—5 years.

To Bridier, Royer, of Sedan, for a malt mill—10 years.

To Croisat, Ferdinand, of Paris, for a hair brush—5 years.

To Guilbout, Alexander and Bondot, Vincent, of Paris, for a system of machinery for roving and drawing silk, cotton, &c.—5 years.

To Gaulofret, junr. Joseph, of Marseille, for a process to revive animal coal—10 years.

To Arizolli, Barthelemi, Francois, of Paris, for cast-iron chimneys—15 years.

To Comte de Rochelines, Jean Baptiste Richard, and Fabricius Leonard, of Douai, for a mechanism to prevent the upsetting of coaches—5 years.

To Bernardiere, Achille, for manufacturing fine baskets, &c. with whale bone—5 years.

To Richard, Jean Jaques, of Paris, for manufacturing divers articles in cast-iron instead of cast steel—5 years.

To Collain, Jean Pierre, Francois, of Sabrian, for a serpentine chimney and fire-place in union with a boiler—15 years.

To Irving, of Paris, for applying the atmospheric pressure and vacuum to produce a rotary motion—10 years.

To Boulet Jacques, of Paris, for a process to strengthen carded and combed wool, &c.—15 years.

To MM. Canson, brothers, of Annonay, for a process to size paper in the vat—10 years.

To Simon Nicolas, of Saint Die, for a portable kitchen-garden—5 years.

To Prudel Pierre, of Carcassone, for a cloth shearing machine—10 years.

To Siau Barthelemi Gaulofret, junr. and MM. Boffe, brothers, Melchoir Francois and Jean Baptiste, of Marseille, for a process for manufacturing glue from gelatine—5 years.

To Becker, Henri Guillaume, of Strasbourg, for a new high pressure locomotive steam engine—10 years.

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## NOTICE TO SUBSCRIBERS.

Our subscribers will perceive that a slight alteration has been made in the title of this Journal. The Franklin Institute having assumed the publication of this work in January, 1828, they have determined to give it such a title as would mark its immediate connexion with the Institute—new title pages are furnished with this number, which the subscribers will please substitute in the place of those formerly issued, with the two volumes already published for the past year. This number, therefore, will commence the third volume of the new series.